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PROCEEDINGS

OF THE

CALIFORNIA ACADEMY

OF

SCIENCES.

VOLUME VI.

1875.

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1876.

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OF THE

CALIFORNIA ACADEMY

OF

SCIENCES.

ANNUAL MEETING, JANUARY 4TH, 1875.

Vice-President Hewston in the chair.

Fifty members present.

In the absence of the President, the Vice-President read the annual address.

The Corresponding Secretary read his annual report, stating that the correspondence is becoming more extensive and important with the growth of the Academy.

The Recording Secretary submitted a brief report, giving the average attendance at meetings as 31 members, and the total resident membership as 301, and the life membership 78.

The Treasurer's annual report places the balance on hand at $2,958.43.

The Librarian's report gives the number of books in the library at 5,000 volumes, 2,500 of which are bound.

Dr. A. B. Stout, from the committee appointed to gather information sought by the French Acclimatization Society, reported that certain of the questions had been answered by different individuals. The report was accepted, and Dr. Stout was

requested to forward the material to Consul Breuil, for transmission to the Acclimatizing Society of France.

The reports of the Judges and Inspectors of election were received, signed by J. H. Smythe and Henry Chapman, Judges, and John Currey and J. D. Pierson, Inspectors. They reported the result of the annual election, as follows:

PRESIDENT.

GEORGE DAVIDSON.

FIRST VICE-PRESIDENT.
HENRY EDWARDS.

SECOND VICE-PRESIDENT.
HENRY GIBBONS, Sr.

CORRESPONDING SECRETARY.
HENRY G. HANKS.

RECORDING SECRETARY.
CHAS. G. YALE.

TREASURER.
ELISHA BROOKS.

LIBRARIAN.
Wm. J. FISHER.

DIRECTOR OF MUSEUM.

ALBERT KELLOGG.

TRUSTEES.

DAVID D. COLTON,
JOHN HEWSTON, Jr.,
ROBT. E. C. STEARNS,
GEO. E. GRAY,
RALPH C. HARRISON,
THOS. P. MADDEN,
WM. ASHBURNER.

Regular Meeting, January 18th, 1875.

Second Vice-President Henry Gibbons, Sr., in the chair.

Seventeen members present.

Donations to the Museum: The Alaska Commercial Company donated two Aleutian mummies, a complete description of which appeared in the *S. F. Chronicle*, of January 8th, 1874; Jesse

Walton donated specimen of *Liparis pulchellus* (?) or *mucosus*, Ayres; Mr. B. L. Savory, of Tuolumne County, presented, through Mr. Brooks, two specimens of pound pear, one picked from the tree October 1st, 1873, and the other fresh.

The Vice-President stated that General Cobb had signified his intention of depositing in the Museum of the Academy, the articles found in the shell mound at Saucelito.

Dr. Kellogg exhibited plants, and read a paper on California and Colorado Loco Poisons.

California and Colorado "Loco" Poisons.

BY DR. A. KELLOGG.

Dr. Kellogg stated that very many thousands of horses, cattle and sheep had been poisoned by plants, exhibited and accompanied by sketches, called the Rattle Weed, Pompous Pea, Pop Pea, or Menzies' milk, Vetch, (*Astragalus Menziesii*, Gray) of the vicinity of San Francisco, and also quite widespread over the State. The fact had been known to himself and to the public for the last ten or fifteen years. How long it has been known to the native Californian he was unable to say, but reiterated experience has taught sad lessons to independent observers everywhere. To some, however, the cause of their misfortune still remained a mystery. He had reason to know that there are also other similar causes, of which more would be said hereafter.

The subject had been frequently brought before the Academy, but as no records had hitherto been made, he thought it proper to suggest that much useful information was often thus lost—was glad to add that no such fault could be attributed to Mr. Yale, the present indefatigable Secretary.

This, and some allied forms, have been figured and published here; so that the public are supposed to be somewhat familiar with it.

The plant has much the appearance of *Bladder Senna*. As no chemical analysis has been made, nor any carefully-noted experiments tried on animals, all we know is the serious results, often obscurely and imperfectly reported by the farmer, ranchero or herder, and the shepherd.

Horses and cattle in this vicinity, he noticed, would shun it so long as the pasture was good, but as it became bare, and hunger impelled, they would eat it, and became narcotized or intoxicated, stagger, and are unsteady in all their movements, act strangely and stupidly, losing their good "horse sense" or common brute sagacity, in short, acting like a *fool;* hence the Mexican name, "*Loco*," given it. At length they become thinner, and cannot be restored to "condition." The brutes get to like the weed more and more, being apparently as infatuated as the Sandwich Islander is for his "Ava," (*Macropiper methysticum*,) in water, which demoralizes worse than ardent spirits, or the drunkard for his bottle. If only slightly "*locoed*," the animal, to a great extent, becomes unfit for uses, except the simplest kind, being unreli-

able in perilous paths or ordinary emergencies, acting so like a fool, to the shame of all sensible animals.

What is most remarkable with this, and the Colorado *Loco*, is the permanence of the impression, often lasting many months, or even for years, half demented, until at length they die. Death often supervenes suddenly; the effect is similar with horned cattle and sheep. The allied *Tephrosia*, or Devil's Shoe-string of the south, although it stupifies and intoxicates, yet the impression soon wears off. This species of Rattle Weed is by no means confined to damp ground, but thrives well on dry hills and all soils. The stem is tall and leafy, growing in bunches from a perennial root, leaflets many-paired (twenty or more), stipuls at base of the leaves trianguloid, membranaceous flowers dirty pale yellowish or whitish, tinged with red, bent forcibly back. Pods inflated, about two inches long, and thinly membranous, indeed so bladder-like that boys amuse themselves by popping them—hence the name "Pop Pea."

Lambert's milk-vetch, of Colorado Territory, *Oxytropis Lamberti*, Pursh; (*Astragalus Lamberti*, Spreng.) consists of about six to eight varieties, which, for all popular purposes one description might suffice. The root is perennial, stemless, or nearly so—not considering the flower or fruit-scape, as such—they grow in tufts or stool-like suckers, springing out by very short branches from the root-crown—are more or less silvery, satiny-silky in every part; the common leaf-stem is about three inches long, the upper oddly pinnate portion the same, or whole length of leaf about six inches, or much shorter than the flower scape stem; pea-blossomed flowers, purplish, blue and white, violet, etc.; leaflets five to fourteen pairs, usually about eight or nine; stipular appendages at the base of the leaves, at, or under the soil, sheathing; pods white, satiny-silky, with very short close-pressed hairs, erect, somewhat cylindric, one-half to an inch long, sharpening out at the point, and partly two-celled.

Found from Saskatchewan to Texas, New Mexico, west to Rocky Mountains, and Colorado to Washington Territory, and, in the opinion of Hooker, to Arctic America and Labrador.

Of this species of "*loco*" we have no personal observation. Asst. Surgeon P. Moffatt, U. S. A., writing from Fort Garland, Colorado Ter., says: "Cattlemen inform him that the weed abounds in damp ground; he is assured that after eating it the animal may linger for months or years, but they invariably die from its effects. The animal does not lose flesh apparently, but totters on its limbs, and becomes crazy. While in this condition a cow will lose her calf and never find it again, and will not recognize it when presented to her. The eyesight becomes affected so that the animal has no knowledge of distances, but will make an effort to stop, or jump over a stream or an obstacle while at a distance off, but will plunge into it, or walk up against it on arriving at it. The plant pointed out to him seemed related to the Lupin."

The members were notified that the appointments of corresponding members would be made shortly, and those desiring to present names could do so by leaving their lists with the Secretary.

VOL. VI.

REGULAR MEETING, FEBRUARY 1ST, 1875.

Second Vice-President in the Chair.

Forty-five members present.

The following new members were elected:

Cornelius Herz, Horatio Stone, J. R. Scowden, Jeremiah Clark.

Donations to the Museum: From I. C. Raymond, a valuable case and drawers. From J. C. Merrill & Co., the spy-glass that originally belonged to Capt. Wm. Bligh, who commanded H. B. M. ship *Bounty* when taken by the mutineers, who afterwards settled Pitcairn Island. The glass was left at Tahiti, and came into the hands of Kamehameha III of the Hawaiian Islands, and was presented by Kamehameha V to Capt. Joseph Smith, who left it with Messrs. J. C. Merrill & Co., who present it to the Academy. They also donate a family Esquimaux boat or "oomiak;" also teeth of whale. Dr. H. Behr presented the web of the larvæ of the Eucheira Socialis from New Mexico, found in about the same climate as California. It feeds on a species of arbutus, and could therefore be introduced if desired. It forms a waterproof sac or bag into which it retires for shelter from rain or storms. This bag is remarkable for its exceeding delicacy and lightness. W. G. W. Harford presented several specimens of Crustaceæ from Santa Barbara, *Epicellus productus*, *Hippa analoga*, and two other species. W. J. Fisher presented thirty specimens of Crustaceæ from Japan, Behring's Straits and Arctic Ocean. Several of these species are new, and none of them are in the cabinet of the Academy.

T. J. Lowry, of the U. S. Coast Survey, read the following:

The Protracting Sextant—A New Instrument for Hydrographic Surveying.

BY T. J. LOWRY.

Sextants, and the three-arm protractor, are indispensable instruments, in hydrographic surveying. And in the special work of determining and plotting the position of the sounding-boat or vessel in the usual manner by the *three-point problem*, they are the only instruments of precision in use; and yet the

facts of there being three separate instruments and requiring the simultaneous and rapid manipulations of two observers (and their subsequent efforts in setting off the angles on the protractor) have long been felt to be defects. And the hydrographic world has studied, but unsuccessfully, to devise an instrument that would do the work of these three. But this problem finds a solution in my *protracting sextant*, which enables one observer to accomplish in hydrography the desideratum of measuring at the same instant two angles, and plotting them with the same instrument.

We have represented here in the annexed figure, "The Protracting Sextant," consisting of a circle *D*, graduated to degrees and minutes from the zero point around by the right and left each way to one hundred and eighty degrees, and three radiating protractor arms, *f*, *g* and *h*. The arm *g*, is fixed with its true edge at the zero point of graduation, and the other two, *f* and *h*, are capable of being revolved around the hollow cylindrical axis of the circle. Between this fixed, and each of these movable protractor arms, we have an index arm—and each of these indices, *m* and *n*, also find in the center of the circle a common center of motion, and carries an index-mirror mounted perpendicular to its plane of motion but slightly eccentrically so that the hollow axis of the instrument can be readily gotten at. Along these index arms *m* and *n*, are cut rectangular slots (whose longitudinal axes are radii of the circle), in which slide the projecting ends of the pivots which rivet the equal rectangular bars, *o*, *s*, and *u*, *w*, together. And these indices and protractor arms are so connected by means of jointed parallelograms that the right hand index-arm always bisects the angle included between the fixed and right hand protractor arms, and the left hand index always bisects the angle contained by the fixed and left protractor arms.

Now by a well-known optical principle we know that the angular distance moved over by a mirror while measuring an angle is only one-half of the actual angle measured, and since each of the movable protractor arms of this instrument is by means of this jointed parallelogramic gearing, driven along its arc simultaneously with, and *twice as fast* as its corresponding index-arm (and mirror), we hence see that the angles included between the fixed and movable protractor arms are the actual angles which the indices (and their mirrors) have measured.

The index mirrors, *y* and *z*, may be mounted to move either in the same or in parallel planes, as shown in the forms of the writer's two-angle sextants described in the proceedings of the Academy, February 16th, 1874. A horizon glass, *x*, half-silvered to admit of direct and reflected vision is attached to the frame of the instrument nearly opposite the index mirrors, with its plane perpendicular to the plane of the instrument. The arms, *f* and *h*, are clamped and adjusted with the ordinary clamp and tangent screws, *l* and *k*.

The requisite adjustments of the "Protracting Sextant" are the same as those of the ordinary sextant. When observing with the new Protracting Sextant, the hydrographer holds it lightly in his right hand and moves it until its face is in the plane passing through his eye, *i*, and the three objects, *A*, *B*, *C*, whose angular distances are required, and then sets and clamps his index arm so that the reflected and direct images of the objects (say left hand and middle) of one of the angles which he is to measure, are not coincident

yet approaching on account of the progress of the boat; then with the second index glass he makes the direct and reflected images of the middle and right hand objects coincident, and keeps them coincident with tangent screw until the first two objects become coincident, then clamps, and he has the two angles observed at the same instant—and also has them set off on the proper limbs of the instrument simultaneously with, and by the same effort that measured the angles. And hence after measuring two connected angles with this instrument, we have only to lay it down on the "Field Sheet" (which should always be spread on a board before the observer in the boat), and shift it until the fiducial edges of the three protractor arms traverse the three points (representing the signals observed upon), and the center of the instrument will then occupy the relative place of the observer; now dot the center, and the position is plotted, without any of those tedious transfers of angles from the limbs of sextants to the limbs of the protractor, which are unavoidably incident to the execution of practical hydrography with the forms of sextants and protractors now in general use.

However, with the hydrographer, it is necessary to read the angles off of the instrument and record them for future reference and closer plotting on the "Office Sheet."

The angles observed with the Protracting Sextant, or any other reflecting instrument, are measured in the plane of the objects. If this plane be inclined to the horizon and a result rigorously accurate be sought, the angles of elevation of each station above the horizon should at the same time be observed to afford data for reducing the hypotheneusal to the horizontal angle. But this reduction may be neglected in all cases where the difference of elevation of the objects does not exceed two or three degrees, and when the observed angle is larger than (the minimum angles allowed in determining a boat's position by observations from the boat), twenty or twenty-five degrees—for the reduction to the horizon would, in such cases, deal with quantities more minute than the amount of error to which the measures of all angles observed at an unstable station are liable. When the difference of the objects is considerable, an ideal vertical line may be drawn from the highest object downward to an elevation corresponding to that of the lower object, and the angle measured between this vertical line and the lower object —this with some experience and correctness of eye, will give results sufficiently near the truth, *i. e.*, within the limit of the errors of plotting. Objects very close should not be observed on account of the parallax of the instrument.

The Protracting Sextant should have supplementary attachments (such as were described by the writer before the Academy, February 16th, 1874), so that angles between one hundred and forty and one hundred and eighty degrees may be measured with equal facility with those of smaller magnitude. But these larger angles cannot be plotted in the usual way, for they are too great to be set off at the same time on the limbs of the instrument because of the jamming of the movable protractor arms; now, under this contingency, if we have no tracing paper, and don't wish to sweep the circles of position, then we may use the following easy and accurate method of plotting by supplementary angles, viz.: Suppose A, B and C, the left, middle and right hand objects on which are measured two angles, too large to be set off on the

limbs of the protractor at the same time, then set off the supplement of the left hand angle on the right hand limb, and the supplement of the right hand angle on the left hand limb; cause the right and left arms of the instrument to traverse points A and C, respectively, and draw a line along the middle arm, then shift the center of protractor (taking care to keep the points A and C bisected by the true edges of right and left arms), and draw another line along middle arm and the intersection J, of the two lines thus drawn, will be a point on the right line through point B, and the required place of observation; draw this line through B and J, and with the center of the instrument on this line, cause the fiducial edges of the right and left arms to traverse A and C respectively; dot the center, and this is the place of observation.

Another method of plotting a position by supplementary angles is to set off the right hand angle on the left hand limb, and the sum of the supplements of the observed angles on the right hand limb of the protractor—cause the left, middle and right arms to traverse the middle, right and left signals, respectively; dot the center, and it is the required position.

And this instrument also enables the hydrographer and topographer to determine and plot their positions by the two point problem (in a manner equal in accuracy and second only in point of simplicity to that by the three point problem), as shown by the writer at page 18, Vol. 2 of "The Analyist." And, in fact, with one piece of tracing paper and the Alidade, the topographer can plot his position, by the three point problem—and with two pieces of tracing paper and the Alidade, he can plot his position by either the two or four point problems shown by the writer at page 146, Vol. 1, of "The Analyist."

This instrument also furnishes the ready means of *orienting the sounding boat.* If out in a bay, lake or river, or along near the sea coast, and your compass functions badly, and you have while angling and plotting, or for some other reason lost your bearings, and hence wish to catch some fixed object ahead or astern on the general direction of the line you wish to run—then take from the sheet, with the Protracting Sextant, the angle between some visible signal and the general direction on which you desire to continue your line of soundings, and then lifting the instrument to your eye, shift it until you bring the image of this signal into the horizon glass, and whatever fixed object this image then covers will be a point on the desired course. By this means, the hydrographer, even if out on a large expanse of water, and swept about by winds and currents, with his compass crazed by local attraction or the heaving of the waves, may "orient himself," and thus ply the helm more intelligently. And, in fact, by this maneuver, and by observing (and plotting as you go) twice or thrice as many angles as must necessarily be recorded, the boat can be steered without the aid of the compass. These practical hints will be found to come most opportunely to the relief of the distressed hydrographer when surveying close in shore along much of the Pacific coast, with its beaches of ferruginous sand, or along the iron bound shores of Lake Champlain, where the magnetic needle often becomes worse than useless.

In nothing will the skill and dexterity of the hydrographer be more advantageously displayed than in deciding *at once* upon the line his boat is to pursue, and with the glance of intuition grasping all the conceivable combinations of visible points that will determine his position. But in practical

hydrography no less necessary than this skill and dexterity, is rapidity of execution in determining positions; and, to this end, with two observers, the requisite promptness and oneness of action are found deplorably deficient, and that, too, at moments the most critical. A sunken rock or reef is to be determined, and on it a sounding gotten. The rock is found, the "cast" is taken—the word "stand by for an angle" is given—and at length comes the response, r-e-a-d-y; by which time perhaps a tangent screw is jammed (hard up) or the boat has drifted from over the rock, and thus the reward, for hours, or it may be for days, of persistent and arduous exertions is lost. And such mishaps must ever continue to recur where two observers are called upon to act quickly and simultaneously under exciting circumstances.

But if in the boat there is *only one observer*, with a Protracting Sextant, then we may confidently expect that promptness and oneness of action, in observing, under every contingency, which are so essential to the rapid and successful execution of a hydrographic survey.

Although we do not presume to say that the theory of this instrument is so obvious, or its manipulations so simple, that "the simpleton, though he run may understand," or that the smatterer and blind routiner (who could not look a quadrilateral in the face without blushing) may manipulate it with ease and accuracy, yet we do not assert without the fear of a contradiction, that to the eye of the ingenious geometer, its theory is most clear, and that in the hands of the hydrographer, who is a master of his profession, this Protracting Sextant will be found the ready and efficient means of determining and plotting (unassisted and alone) his position, with a facility, ease and accuracy not now attained with two ordinary sextants and one protractor in the hands of two observers and one plotter.

The Secretary read the following from Professor George Davidson:

Transit of Venus.

BY GEORGE DAVIDSON.

To the California Academy of Sciences, San Francisco, Cal.:—The instructions of the Commission permit me to give general results of our work, and I condense as much as possible for presentation to the Academy, our labors of preparation and final results.

We have determined the difference of longitude by cable, between Nagasaki and Vladivostok, whence it will be carried westward to St. Petersburg by telegraph, and in connecting the Venus Station with the Telegraph Observatory we have determined the latitude and longitude of the French Venus Station and two other points on the bay.

We have determined the latitude of our station by the Talcatt method; observing upon twenty pairs of stars for five nights.

We have observed fourteen occultations of stars by the moon for longitude differences with Peking and other stations. This was work which we had to

discontinue on account of the smallness of the party and the continued hard labor to be done.

Incidentally we have determined the magnetic declination, magnetic dip, and horizontal intensity.

Of course all our work looked to only one object—the Transit of Venus. And in order to be properly prepared for work thereon, I had erected on a hill, 900 feet high, three miles to the north of our station, an artificial Venus under four different phases. First, when the planet was about four-fifths or more on the disc of the sun; this was for practice in measuring the distance apart of the cusps by means of the double-image micrometer of the equatorial. Then when she was 40 seconds on the disc. This was to study her appearance and to measure with the micrometer the distance of the limb of the planet on the sun's disc. A third phase was when Venus was 40 seconds wholly within the sun's limb. This was for measuring the distance apart of the limbs of the planet and of the sun. Another phase was to study her appearance when only 10 seconds on the sun's disc; and this was one of the most instructive studies, as convincing one that, with instruments the size of our equatorial, that is, 5-inch objective, it is next to impossible to observe the contact with the eye alone, until she has entered fully five seconds. Another practice was to measure the diameter of the artificial planet. As these phases of Venus were drawn to appear of the same size as I should see her, the practice of measuring upon them, under all circumstances, of clear and cloudy weather, steady and unsteady atmosphere, gave me confidence in what I should be sure to see in a week or more.

Before the day of the transit we were ready and anxious for the event; the weather was gathering for the worse and the prospect was decidedly bad. On the morning of the 9th, at 4 A. M, when we observed star transits, the sky was as clear as a bell; at 5 A. M. densely clouded. The clouds broke partially at about half past 8 A. M., and we obtained our preparatory photographs and had all the final adjustments made by 9:15, when the clouds thickened, and the prospects were dark as the lower stratum of clouds touched the mountain top four miles south of us and only 2,000 feet high. There were two strata of clouds—the upper one, moving very slowly, was a curtain of cirrus and cirro-stratus; the lower gathering heavily and slowly from the southwest, was cumulo-stratus. Ten minutes before the first contact a break in the lower stratum occurred, and near the first. · I was sure of it, but a thicker mass deadened the image so that I could not be sure of the contact; and when the light increased, the planet was certainly ten seconds on the sun's limb. Then the clouds increased, and no measures for cusps could be undertaken until the planet was half way on, when it became bright, and I observed the second contact as well as such an event can be noted by eye alone. There was no ligament joining the limbs of Venus and the sun; no black band or black drop. There was a slight unsteadiness of limbs, such as we see in our regular groedetic work, but no hanging together, no distortion of outline of either. The separation might have been much sharper, but the result could not raise a doubt of more than two seconds in my mind.

Then I commenced measuring with the double-image micrometer the separation of the limbs until Venus was on one diameter; then made measures

of the diameter of the planet. These were made to study the question of irradiation. During this time there was no sign of an atmosphere or haze around the planet. In these different measurements about 150 micrometer readings were taken. I should here mention that Mr. Tittmann, the first assistant astronomer, also observed the second contact with the Hassler 3-inch equatorial of the Coast Survey, and noted no ligament or band.

After diameter measures came thicker clouds, but fortunately at noon they broke away, and with the Coast Survey meridian instrument No. 2, I was enabled to observe the meridian transit of the sun's first limb over nine threads, the first limb of Venus over eight threads, the second limb of Venus over eight threads, and the second limb of the sun over six threads. Mr. Tittmann with another transit measured the difference of declination of the upper limb of the sun and both limbs of Venus by eighteen micrometer readings. These meridian observations and the diameter measures were not contemplated by the Commission.

Then the weather thickened and threatened rain; but at third contact broke away slightly, and I was defeated in the third contact. Just a few seconds before, I had the line of separation very narrow and well defined, and without ligament, but the clouds deadened it, and even without colored glass it only cleared to let me see that the planet had broken across the sun's limb about five seconds; thence to close, dense clouds.

During the day there was no time after 10 A. M. when the sun shone from a blue sky. The upper stratum of clouds acted as a screen to the sun's heat-rays, and the atmosphere was quite steady. Objects at a distance were dark but clearly defined.

Of photographs we got none near first contact; only began to receive them when the planet was half on. After that we obtained about sixty good ones.

Altogether, with the second contact, the micrometric measures, the meridian transits, and the difference of declination, and the photographs, I believe we have more than average satisfactory results. We did our best; there was no hurry, no jar or clash or hindrance; everything worked smoothly and like machinery, as by our practice and drill we had anticipated.

Our observed first and second contacts were about 1 min. 45 seconds after American Almanac data, and about 3 minutes 30 seconds after the English. The third contact was near the time of the American data.

Enough. In a subsequent letter I will place before the Academy my opinion of methods and instruments and elevations to be chosen for the transit of 1882.

Dr. Gibbons read a paper on "Climatic Changes in California."

W. N. Lockington read a paper on "Sponges."

westward, we also find the few older forms developing into many "specialized" varieties.

Going south of California we find further confirmation of the theory of southward migration in Mexico, where species closely resembling the *Pomatia* of Europe occur on the higher mountains, which, unless special creations, could only have reached the two regions by a process like that I have described. The genera *Bulimus*, *Glandina* and *Clausilia* may also have traversed a similar route, though their absence in the tertiary strata of the Eastern States seems to be evidence to the contrary. They may, however, be found in the tertiary of the Great Basin, which is known to contain fossils of some other genera now found only south of the United States (*Berendtia* and *Holospira*). Indications, however, are known, which point to a connection of tropical regions by land in tertiary times, independent of a polar route. The supposed "Atlantis" connecting South America with Africa would also have connected it *eastwardly* with Asia and Oceania.

The humble and despised snails thus become among the most important evidences of geological changes and conditions of the land, climate, etc., in the past history of the globe. Being terrestrial and easily fossilized when of moderate thickness, they furnish evidence not supplied by any other class of fossils, while their persistency of types is shown by the close resemblance of the carboniferous species to modern tropical forms. One species at least, which still lives in the Eastern States, is found only fossil in England (in Pliocene or later strata) like the trees found under similar conditions, and careful examination of fossil forms on both continents will no doubt show other curious coincidences.

It may be mentioned also that genera of abundant occurrence in the Eastern States have a few representatives in Europe and Asia, as they have on this Coast.

Every fact like this tends to prove that their former migrations have not been to the east or west, but from a common northern centre toward the south.

On Shells of the West Slope of North America.

No. III.*

BY J. G. COOPER, M. D.

Genus Helix Linn. A very thorough investigation of the subject with the aid of all the light afforded by the works of Pfeiffer, etc., has brought me to the conclusion that the *Linnean* type of Helix must be a form very different from *Pomatia*, and probably including the Californian banded forms. After excluding *Planorbis*, a prior genus, *Pythia*, and perhaps others, not agreeing with the diagnosis, the first Linnean helicoid land-shell is *H. lapicida*. Although this does not agree well with the diagnosis in form, it has been shown by Mörch to be of the same genus, as to the soft parts, lingual teeth, etc., as *H. arbustorum*, and probably *H. Hispana*, which are typical in form, and were

*See Vol. III, pp. 62, 259, 294, 331, IV, 92, 150, 171, V, 121, 172, and Amer. Jour. Conch.

placed by Linnæus in about the middle of the series, *H. lapicida* representing indeed their carinated condition. Furthermore, Pfeiffer only quotes Edition XII, for "*H. Pomatia*," while the genus *Helix* was founded in the Systema Naturæ, Ed. X.

Other species have been subsequently adopted by authors as the type, but the laws of nomenclature seem to require that the first-named, or most typical and well-known species of the author, should be considered his generic type. *H. lapicida* occurs in Sweden, but none of those adopted by southern authors do so. Each of the latter seems to have taken a form used as food or medicinally, but less known to Linnæus. Until Hanley identified the Linnean types of species, two of them were even supposed to have been unknown to him! We may therefore give:

1. *H. lapicida* (or *H. arbustorum*) as type of Linn.
2. *H. grisea* L. (="*aspersa* Müll." *Hanley*) as type of Risso.
3. *H. Pomatia* L. (Syst. Nat. Ed. XII) as type of Fitzinger.
4. *H. lucorum* L. (="*lactea* Müll." *Hanley*) as type of Swainson.

Thus it becomes necessary to consider *H. lapicida* the Linnean type, and *Arionta arbustorum* as subgeneric, though Mörch has placed them in the contrary positions. As to *H. Hispana* there seems to be some doubt, as it was not recognized by Hanley among the types, and the description is not full enough. If, however, it is the *H. umbilicaris* Brum., it is the type of *Campylæa* Beck, which probably includes part of the Californian species, formerly placed by me in *Lysinoe* (*Aglaia* part, auct.). It comes nearly between "H. fidelis" and "H. Dupetithouarsi." *C. setipila* Ziegl. is placed next to *H. Mormonum* by Pfeiffer, and retains its bristles permanently, like var. *Hillebrandi*. Besides the 1-banded or fillet-banded series like ours, there is another in Europe with 3 or 4 bands, which seems a passage to the § *Pentatæniæ* to which *Pomatia*, etc., belong. Compare also "*H. peliomphalia*" Pf. and *H. Simodæ* Jay, of Japan, *H. Middendorfii* Gerst. Amoor R., *H. jaspidea* Pf. and *H. Patasensis* Pf., Andes, Peru. Species are included in *Campylæa* that are subangled, (e. g. *C. Banatica* Partsch, and *cingulella* Ziegl.) thus approaching *lapicida*, which is said by Mörch sometimes to "have four bands like its allies," but he may confound two species in this case. One, *C. Raspailli* Payr. is imperforate.*

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*I am indebted to Dr. Newcomb for the use of numerous Conchological books.

The shell figured by Chenu (Manuel, I, p. 461) as "*Macrocyclis* (*Vallonia*) *pulchella* Müll.," is a species of *Campylæa* much like *Hispana* (*umbilicaris*) or *cornea*. The error probably arose from the confusion by some authors of *Corneola* (type *pulchella*) with *Campylæa* (*cornea*).

"*Helix peregrina* (Bosc)" quoted by Bland & Binney (Pulmonata Geophila, 186), from "the islands on the west coast of America," is probably Gmelin's species of same name, which Pfeiffer has shown to be probably the same as the "*H. octona*" Chemn. (not of Lam.), *Stenogyra octona* of B. & B. p. 232, quoted by Pfeiffer as from West Indies, Guatemala, West Columbia, Pacific Is. (Opara, etc.) Chemnitz no doubt mistook it for the Linnean *H. octona*, and Gmelin rectified this by calling it *peregrina*, which name probably belongs to the West Indian shell, not in Mex. or Cal. In Pfeiffer's synonymy is also *Achat. Panamensis* Muhlf. Mss., not *Bulimus Panamensis* Brod., but Dr. Newcomb tells me the Panama animal differs from the West Indian, and also considers those of the Pacific Islands distinct.

The following papers by Dr. J. G. Cooper were submitted:

The Origin of Californian Land-Shells.

BY J. G. COOPER, M. D.

In previous articles I have given some observations on the Distribution and Variations of the Californian Banded Land-shells, which naturally lead to the consideration of their probable origin or past history.

In the "Bulletin of the Museum of Comparative Zoölogy," (Cambridge, Mass., June, 1873, p. 202), Mr. W. G. Binney writes, "the west alone is left to us from whence to trace the Pulmonate Fauna of the Pacific region, and there the secret of its origin lies buried under the Pacific Ocean."

Mr. Binney probably alluded to the supposed existence of a continent in the South Pacific, embracing the mountain summits now forming the archipelago of Oceania, which became submerged, as Prof. Dana suggests, during the later tertiary period, while most of California was emerging from the ocean.

But even if this were proved to have happened, the great distance of the nearest islands (the Hawaiian) from us, and the great depth of the ocean between, as well as north of them, besides the total dissimilarity of their living land-shells from ours, forbids any supposition of a former land connection by which such animals could travel directly from one country to the other. A glance at a globe shows that the islands, besides being tropical and wholly south of lat. 23°, are as far from us as the Aleutian Islands, the Arctic Ocean, or Florida, and I propose to show that whatever migration to California has occurred, came from the direction of the regions named last.

No confirmation is given to a derivation from the west, by the more probable former existence of an "Atlantis" connecting the two continents across the Atlantic, the few island remnants of which really contain several species of land-shells common to one or both sides.

The great similarity of our banded groups to those of Europe has always been an argument for supposing them to have had a common origin. The same similarity is found in many others of our animals as well as plants, and is plainly connected with the well-known similarity of climates in the two countries. But as the known laws of nature do not permit us to consider climate as the cause of specific resemblances, we must look for some other way of accounting for them in this case.

The fact that very similar species exist in Japan and the Amoor Valley, Siberia, contradicts, indeed, the theory of climatic causes, since we know that the climate of those regions is very similar to that of our Atlantic States, where no similar species exist. At the same time, their existence there suggests the probable central point from which all originated.

Going back in geological history to the supposed beginning of all living species, few, if any, of the terrestrial, can be traced farther back than the

Eocene Tertiary, and most of them much less far. But some included in the comprehensive genus "Helix," are found fossil in the Eocene of Nebraska, etc., sufficiently like living American forms to be considered the "Darwinian" ancestors of perhaps the whole of them! Or we may go back only to the Miocene epoch, when trees scarcely distinguishable from the Californian Redwood and *Libocedrus* flourished in Greenland and Spitzbergen, between lat. 70° and 78°. What is more natural than to suppose that land-shells also, like those now living among our redwoods and cedars, existed in the shade of those trees? I have no doubt that such will yet be found fossil in the lignite beds of the Arctic Zone.

It is easy then to see, that having their central position (if not their origin) in points so near the present North Pole, the subsequent gradual cooling of those regions, which is supposed to have driven the living species of Redwoods southward to California and Japan, as well as other trees into Europe, would, if a slow change of climate, also drive southward the land-mollusca "at a snail's pace" into the same regions, where we now find their descendants occupying countries, which are about equidistant in longitude, around the northern hemisphere, in lats. 40°–50°.

We have strong confirmation of this theory, in the well-known distribution of circumpolar species of land-shells southward, on both continents, along meridians of similar temperature, and along mountain ranges (especially those running southward, as in America), and which are supposed to have thus migrated south during the "Glacial Epoch."

Besides these two groups, the "circumpolar" and the "representative" species, we also have on the west slope a very few of the Eastern American types. I do not, however, consider these as evidence of a migration *westward*, but would explain their occurrence as proving a former existence of ancestors common to both, in the middle regions of Oregon and Nebraska, where are found so many tertiary remains of animals that once inhabited both regions, before the Rocky Mountains became a barrier to migration, or caused different climates on the two slopes.

The few fossil land-shells yet found in California are not sufficiently abundant or ancient to furnish data for their geological history. The fresh water forms, however, which I hope at some future time to describe and illustrate, indicate a very different and more tropical group in the Pliocene and Miocene strata.

The occurrence of *Pupa* and *Conulus* in the carboniferous strata of Nova Scotia, shows that land-shells existed long before the Eocene period.

The great northern glacial drift, and local glaciers farther south, have so generally destroyed the softer tertiary deposits that it must be long before the routes of migration can be traced from Greenland southward, but as tertiary land plants are found there fossil, some similar deposits must have escaped elsewhere in the intermediate regions. Species much like the living ones of California may be expected to occur in the Pliocene of British Columbia.

There can be no doubt that the local migration has been *westward* along this coast, from the facts before stated as to the occurrence of species in the coast ranges and islands, which are unquestionably not older than Pliocene in age, while their allies in the Sierra Nevada may have existed there since the Eocene, but at a greater elevation than they are now found. As they move

and fossil, closely resembling West Indian forms, as well as some of the Canary and Azores Islands, he considers good evidence of the existence of the connecting land "Atlantis" within tertiary periods at least. The circum-tropical existence of this northern group is, however, to be explained in another way by a southward migration, as I have more fully shown in another paper. The repetition of forms with very thick lips, in different longitudes, on islands between latitudes 35° and 30°, is rather the consequence of the excessive development of shell in mild foggy climates, on islands, especially, where lime abounds. The animals may differ very much, as shown by those with similar shells, from New Caledonia described by Crosse & Fischer. The Algerian fossils no doubt lived when the Sahara was an inland sea, and Algeria a group of islands, the later rise being possibly at the time "Atlantis" sunk.

Our fossil island varieties also show the effects of a former moister and warmer climate, perhaps pliocene.

As might be expected, the Algerian shells belong to a different subgenus, forming a gradual series from the toothless *Tachea lactea*, Müll. ("=*lucorum L.*," Hanl.) to one and four-toothed *Dentellarian* forms, and some of the fossils retain the characteristic five bands of the § *Pentatæniæ*.

Our island Helices also connect with the Lower Californian many-banded *areolata*, etc., which much resemble *lactea*, etc., but according to Mörch, Tachea is a subgenus of the carinated genus *Iberus* (type *Gualteriana L.*)

As partial evidence of the greater antiquity of our fossil forms, we may note that numerous eastern species found fossil in the Mississippi valley Quaternary strata, do not differ from those now inhabiting the surrounding regions. In that case, therefore, there may have been no great change of climate.

The angled form of *Kellettii*, found fossil, is the link connecting our "Arionta-form" species with the "Chilotrema-form" *lapicida*, and with the angled forms of the next group.

Subgenus CAMPYLÆA. (?)

H. Mormonum Pf. In their splendid work on the Land Mollusca of Mexico, and also in the Journ. de Conchyl. XXI, 1873, 263, Messrs. Crosse & Fischer give as a locality, "Sonora, Mex., Dr. Frick." This is undoubtedly a mistake arising from specimens collected by him at Sonora, Tuolumne County, Cal., where he informed me himself that he found it common, as well as at Columbia, near the same place, localities noted for the marble and lime mentioned by me in other articles. Lest other foreign authors may suppose this shell to be from Utah, I may state that the original locality, "Mormon Island," is a rocky islet in the American River, Cal., 70 m. N. N. W. of the town of Sonora, and on the same Limestone belt.*

The animal of *H. Mormonum*, (Pioneer Cave, El Dorado Co., J. G. C.), is long and slender, semi-cylindrical, foot not projecting much behind, flattened,

*In the same works the authors repeat the error of locality for *H. Pandoræ*, viz: "Santa Barbara, Cal.," though it has been several times exposed. They also redescribe *Nassa fossata*, Gld., as "*N. Morleti*, Crosse, Habitat unknown." J. de C., 1868, 169, Pl. VI, f. 3.

wedge-shaped. Color dark brown, tentacles darker. Surface thickly studded with paler tubercles very regularly arranged in front, less so behind the shell. A deep furrow at upper edge of foot, which spreads to twice the width of the body, forming a sharp edge all around. Head obtusely rounded, tentacles long and slender.

It resembles that of *H. Traskii* most nearly, differing much from the others nearest allied in their shells.

A remarkably flat variety of *H. fidelis*, found by Mr. Harford at Dalles, Oregon, is so much like forms of this species as to suggest that they are of a common origin. If the animal proves to be intermediate in colors, it will show that they are only varieties of one species, but so far as known, the animals are more distinct than usual in shells no nearly allied.

H. Traskii Newc. Specimens from near San Buenaventura, where it abounds in moist bottom lands, have the young shell bristly up to the growth of four whorls, but the adult shows no trace of this. The animal has the form of that of var. *Diabloensis* (figured in Proc. Phil. Acad. 1872), but differs in paler purplish (not slaty) tint, and tubercles tipped with white, probably only a more southern variation. The young shell is also distinctly subangled, though not always to the same degree, some being far flatter above than others. Out of over fifty adult shells, one measures 1.30 by 0.60 inch, looking like a pale *H. fidelis*, with but 6½ whorls. I found them to be in the habit of climbing small willow trees in a swamp up to a height of 12 feet.

Dr. Yates has found var. *Diabloensis* in Colusa Co., 100 miles north of Mt. Diablo, near Cache Creek, the outlet of Clear Lake, inhabiting only the eastern ridges of the coast ranges as farther south. Also near Calistoga, Napa County. The supposed hybrid mentioned by me in these Proceedings, III, 331, is the type of this form.

H. fidelis var. *infumata* Gld. In a former article, I have stated that specimens from Humboldt Bay are intermediate between the northern and southern shells; also suggesting that the latter might sometimes show the normal bands of the group. I have verified this suggestion by finding a young faded specimen two miles east of Oakland, in which the darker band is quite distinct just above the angle, on several upper whorls, the light marginal "fillets" also showing above and below it This specimen is also roughly ribbed and clouded above, exactly as in *H. lapicida* for which it might be taken if found in Europe.

It will be observed from the description of the colors of the animal here given, that they resemble those of *fidelis*. All the species analogous to "*Campylœa*" differ much more in animals, as well as in shells, than the "*Arionta*" group. This is connected with their extensive range in latitude, while the latter are limited to more constricted circles, as shown in the article on the "Law of Variation."

The animal is black, with brick-red tubercles, conspicuous even to the end of the tentacles, the furrows of the back not quite symmetrical, except one on each side of the median dorsal line. Mantle edge smoky gray. Length twice the diameter of shell; height of body half the breadth of foot. Form and tentacles more slender than in the polished species; tail sharper. The

slender elongated form is always connected with many whorled species, having a rather narrow aperture in the shell.

Specimens from Alameda Cañon, about lat. 37° 30′, its most southern known range, have the scaly epidermis as much developed below as above. As in bristly species this roughening seems to aid in concealing the shell by retaining a coating of mud.

Mr. G. W. Dunn has found many of this species on the branches of Buckeye trees (*Æsculus*) near Baulines Bay, showing another resemblance to its ally *H. fidelis.*

Dr. Yates has found it near Calistoga, Napa Co.

I have also found banded young of all ages under the loose bark, up to 20 feet above the root of a dead tree, at Haywards.

Glyptostoma Newberryana W. G. Binn. In the Amer. Jour. of Conch. V, 190, Bland & Binney call this a "true Helix," but from their description of jaw and teeth merely prove that it is neither a *Macrocyclis* nor a *Zonites*. Since then they have made it the type of a subgenus *Glyptostoma*, from the grooves in aperture. According to the Agassizian rule, the external form of the shell is enough to separate it from the same *sub-family* with any type of *Helix*. The animal differs materially also as follows:

Length 1½ times the width of shell, spiracle just above middle of its back when creeping, only ¼ inch from angle of aperture. Granulations very long and coarse, reticulately furrowed between, and one straight furrow running obliquely down from spiracle toward mouth on right side of body, about five furrows above, and five below it. A distinct furrow around flattened margin of foot, with branches connecting it with another close to edge. Tail flattened and obtusely wedge-shaped without mucous gland. Eye-pedicles nearly one-third of length of body, and like lower tentacles, finely granulated. Foot *narrower* than height of body. Color smoky gray, foot paler beneath, edge of mantle yellowish.

The form of the animal is indeed almost the same as in our species of *Macrocyclis* (and this of course is connected with the similar form of the shell), but the external characters otherwise differ as well as the jaw and teeth.

Genus Mesodon Raf. Rafinesque's "General Account, etc.," 1818, mentions as found in Kentucky, of "Helix four species," while his descriptions of *Mesomphix*, etc., distinctly state that he considered the typical *Helix* imperforate, no doubt adopting the type of his friend Risso (and of Leach?), viz.: *aspersa* (="grisea L." teste *Hanl.*) Taking W. G. Binney's list of species of the "Interior region," it is easy to identify the four nearest to that type, viz.: *albolabris*, *multilineata*, *Pennsylvanica*, *Mitchelliana*. His "twelve species of *Mesomphix*" include some of *Macrocyclis*, *Zonites* (and *Patula?*); his "*Trophodon*, ten species," must include the "*Odotropis*" of next year. Both are from the same Greek words, meaning "toothed whorl." From his later "Enumeration, etc.," 1831, it appears that he divided *Trophodon* into three groups, giving the name "*Mesodon*, 1819," to the first, though it is known only as a catalogue name, the *M. leucodon* of that date. The description "Differs from *Helix* by lower lip

with a tooth. *M. maculatum.* Depressed, five spires, hardly striated, upper lip reflexed, tooth careniform. Fulvous with brown spots," agrees best with *multilineata*, for he does not state that it has a tooth "on the spire," as in *Odotropis*, but a "careniform" ridge on the *lower* (not "inner") lip. Thus Mr. Tryon's statement that he figured *albolabris* as type in Mss. is intelligible, showing that the tooth referred to was not on the parietal wall as usually understood.* We must then suppose that he made the genus to include the species he before placed in *Helix*.

It appears most proper, if we adopt any of Rafinesque's names, to use those published before 1825 in preference to later ones, invented after his mind became affected. His earlier writings are as clear as those of most naturalists of his time, and from his allusion in some places to unjust suppression of his descriptions in Europe, we may suppose he would have done better after 1825 but for his unhappy condition. On this account the name *Odotropis* having an excellent description given with it would be far preferable, if he had not unfortunately omitted to mention a type species. As it is, it can only be used for a section, as done by me in 1868.

As to the distinctness of this genus from Helix as defined before, there can be no doubt, and it is still more different from the *Pomatia* group. The large, typical species all differ definably in shell, jaw and lingual teeth, as well as in the form of the animal, which has the foot less expanded. The nearest approach to Helix, in shell, is seen in *O. multilineata* and *O. profunda*, but their bands and jaws are quite different. As subgenera it includes *Aplodon* Raf., *Polygyra* Say?,† *Stenostoma* Raf., *Triodopsis* Raf., *Dædalocheila* Beck.

Mesodon Raf. only differs from *Odotropis* in absence of a parietal tooth and of umbilicus, and *Ulostoma* is synonymous with *Mesodon*, having a tubercle on the lower lip. *Trophodon* Raf. is doubtfully distinct, connecting *Odotropis* and *Triodopsis*, while *Xolotrema* includes only the imperforate species of the last, connecting it with *Stenostoma*.

The lip and teeth alone furnish only subgeneric characters, and the umbilicus is scarcely of specific value. While some of the above divisions approach nearer to *Helix* in internal characters, their shells are still more different.

M. Townsendiana var. *ptychophora* A. D. Brown, Journ. de Conchyl. 1870, p. 392. =*H. pedestris* Gld. (part, animal excl. smooth var.) 1846.

= *H. Townsendiana* var. Bland & Cooper, Ann. N. Y. Lyc. VII, 362, and var. *minor* Tryon, Mon. Terr. Moll. of U. S.

Hab. Montana and Nebraska, Rocky Mts.

It seems yet unsettled whether this species belongs to *Arionta* or *Mesodon*, and I have been unable to obtain living specimens for comparison. Mr.

**Mesodon* Raf. (1819?) 1831, type *H. thyroidus* Say, *teste* Ferussac (from specimens?), *albolabri steste* Tryon from Raf. Mss. "Type *elevata* Say," *teste* Gray, but this was probably a type of *Trophodon* 1818, which differed in the "upper lip notched." Gray, however, followed the strict rule of adopting the first recognizable species named in Ferussac's catalogue' = *Odomphium* Raf. 1831 (umbilicate group of *Mesodon*).

Raf.'s Mss. figure of "*M. leucodon thyroide*" is certainly *thyroidus*, but called "spotted," and the trinomial term used indicates that it was not his original type.

†This name though anterior, is inapplicable to all the species.

Binney's latest work states that its lingual dentition differs from the other known *Ariontæ*, approaching the last-named genus.

M. anachoreta W. G. Binn. Compare "*H. læsa* Rve." Conch. Icon. *Helix*, Pl. CCX, described as "granulated, *Hab.* unknown."

Subgenus APLODON Raf. "Differs from the genus *Helix* by its rounded mouth, one-toothed columella, and umbilicus. One specimen in Kentucky, remarkable, *A. nodosum*. Three whorls of spire embossed, and lightly wrinkled concentrically beneath" (Journ. de Physique, 1819). The rounded mouth also distinguishes it from *Stenostoma** and there seems to be no species in Kentucky to which it can apply, except a variety of *monodon*, common in the west, retaining the embossing left by the bristles of the young (*Helix Leaii* Ward). That species forms a link between the subgenus *Stenostoma* and the more different group of *Odotropis*, to which I applied it in 1868.

Our two species are so closely connected as to be hard to separate, and one, the *germana*, has often, if not always, the internal tubercle characterizing most of the subgenus *Stenostoma*. They agree with *O. monodon* in fewer ribs on the jaw than in the type forms.

Mesodon (Aplodon) Columbiana Lea. The uncertainty of the difference in the jaws of this species compared to that of *germana* (as described and figured by Bland & Binney in Ann. N. Y. Lyc. N. H. X, p. 304, pl. xiv, f. 2 and 4) is shown by jaws extracted by myself from shells that would probably be all considered *Columbiana* by those authors.

1. A Sitka jaw is strongly arched, with eight broad ribs.
2. S. F. specimens have nine or ten ribs, stronger, but narrower.
3. A Santa Cruz specimen (toothed and imperforate) has them similar, thus exactly filling the gap between B. & B.'s jaw of *Columbiana* with eight narrow ribs, and that of *germana* with eleven broader ones. The proportions they give for the soft internal organs are very unreliable, as alcohol produces very different forms in those of the same species, and they even differ in individuals with season and age (see *Prophysaon*). I am, therefore, compelled to consider *germana* as only a variety of *Columbiana*. This species has been found near Calistoga, Napa Co., by Dr. Yates, with *Vancouverensis*, *infumata* and *Diabloensis*, associated at no other locality.

M. (Dædalochila) Harfordiana Cp.†

I have heard of what was probably this species in the mountains east of

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*This name, used in 1818 and 1831, was evidently intended to include *Stenotrema* described in 1819, that name having been pre-occupied in 1815, and being as applicable to "narrow umbilicus" as "narrow mouth." Raf.'s type *convexum* is prior to Ferussac's name, and his manuscript was probably altered in Europe before printing.

† Genus GONOSTOMA Held. This European form, type *obvoluta*, is connected with my *Ammonitella Yatesii*, by the "*Drepanostoma nautiliformis*" Porro, of Italy, but the three species are different enough, apparently, to form three subgenera. "*H. ammonitoides* Rve." of Australia, is still more like mine in the form of the mouth, but highly colored. The animals of all need thorough comparison, and also with similar concave shells from the Pacific islands. Those who unite mine to Helix should call it "*H. ammonitella* Cp.," there being a *H. Yatesii* Pfeiff. 1855.

San Diego. Mr. Hemphill also informs me that he collected it in Idaho, thus approaching the range of allied *polygyrella*.

Genus Patula Held. Type "*H. radiata* Penn." (or "*H. alternata* Say.," teste Gray, Genera.)

This genus was founded on one of the group of "*Anguispira*" Morse, a name used by me in the "West Coast Helicoid Land-Shells," but according to Bland & Binney includes also *P. Hornii*" Gabb, and *striatella* Anth., with var. *Cronkhitei* Newc., though not the others I included in it.

P. solitaria Say. Compare "*Helix Kochi*" Pf. Monog. I, figured by Reeve, Icon. Pfeiffer places them close together, but the habitat was unknown. If the collector was the Dr. Koch of "Sea Serpent" fame, he no doubt collected it in Osage Valley, Western Missouri, where he exhumed Mastodon bones. The figure looks like one of the varieties of *solitaria*.

Patula pauper Moric. (not Gould) Alaska. "*Helix ruderata*" Stearns, Proc. Cal. Acad. III, 384 (not of Studer). "*Patula ruderata?*" Cooper, Amer. Journ. Conch. V, 202.

Genus Macrocyclis. The animal of the tropical type of this genus seems to need comparison with the northern forms. By strict rules, the name Mesomphix belongs to this group, the type being plainly *concava*, as shown by Ferussac.

M? "*Helix*" *Belcheri* Pfeiff. 1, Reeve, Icon. Compare this with the Alaskan form called "*Vancouverensis*," but which seems different. The locality of Belcher's specimen was unknown, but he visited that coast.

M. Voyana Newc. Found rarely in Alameda County, by Dr. Yates and H. Hemphill, common and large near S. Diego. The animals show the following differences:

1. Alameda Co. Dusky white, back purplish-brown, a distinct dark stripe on each side, running back from base of eye-peduncles, which are whitish-brown.

2. San Diego. Yellowish-white, middle of back, stripes and tentacles all pale slaty.

3. San Francisco specimens (called "*Vancouverensis*") are darker yellow than the last, with no central or dark stripe. They thus agree closely with the description of the animal of *A. concava* by Dr. Binney, but differ much from that of Oregon *Vancouverensis* as described by him and by Dr. Newcomb, in Amer. Journ. of Conch. Vol. I.

The animals of Alaska specimens, with a greener shell, are paler than all the others.

M. Durantii Newc. = *Patula Durantii* of former papers. According to Bland & Binney, this little species shows the same disregard for generic uniformity of size seen in *Patula*, *Zonites*, *Hyalina*, etc., and makes the terminal member of the series on this coast represented by three or four species, regularly diminishing in size.

I have lately found it in one spot (on limestone only), two miles from Oakland, so that its name, from the late President of the University of California, is more appropriate than when given (see these Proceedings, III,

118). It was also found several years ago by Mr. Rowell, at Haywards, also in Alameda Co. I have not found it there, where, however, occur the following mollusca: *Helix Californiensis*, typical, *H.* (var.) *infumata*, *Triodopsis loricata*, *Mac. concava*, and all the species without shells common to California.

Punctum pygmæum Drap. This most minute of our species has lately been found, also, near Haywards, by Dr. Yates.

Succinea lineata W. G. Binn. The specimens from Mojave River mentioned by me in Vol. IV, p. 151 as probably *S. rusticana* Gld., are more likely to be *lineata*, as I found this west of the first locality along Santa Clara River, down to within 8 m. of San Buenaventura. The animal is yellowish-white, paler beneath, eye-tentacles dark, with a dark line running back in the animal's head from each. Shell honey-yellow, thick enough to hide the colors of animals.

S. Sillimani Bland. The Mojave R. specimens mentioned with the above as *S. Nuttalliana* Lea, are probably the present species for the reason just mentioned, this having been found by me in the same swampy thickets. The animal is quite different from that of the last, being lead-color, paler beneath, but showing also the dark lines in and behind tentacles. The shell is greenish, and so thin that the viscera show through it, but is nearly always so encrusted with mud as to partially conceal it. I have noticed the same habit in *S. Stretchiana*, the mud being evidently plastered on in ridge-like layers by the animal itself.

Hyalina arborea Say. Not rare with the *Succineas*, the only place where I have found it near the level of the sea in Southern California. Constant moisture and summer fogs, are found in few other locations southward.

Genus PROPHYSAON Bland & Binney, 1873, type "*P. Hemphilli*" B. & B., Ann. N. Y. Lyc. X, 293-297, Pl. XIII.

The authors remark that they had only compared alcoholic specimens with my description and figure of "*Arion Andersonii*" (Proc. Phil. Acad. 1872, 148, pl. III, f. F). I have compared *their* description and figure with alcoholic specimens of my species, and find that the differences mentioned by them are caused chiefly by the contraction by the alcohol. The distinct locomotive disk, minute caudal pore, and position of generative orifice, all become changed as described by them. The jaw figured by them differs only in being immature, and in some of the ridges being consolidated, thus showing eight single and six double ones, making twenty, as given by me.

This difference, with other possible distinctions in color in fresh specimens, may be sufficient to separate their species by the name of *P. Hemphilli*. Mine is, however, of the same genus, and though I had before suggested a name for it in Mss., I am willing to adopt *Prophysaon Andersonii*. It is not unlikely that the Oregon animal may be the "*Arion foliolatus*" Gld., still imperfectly known. My species is common in winter along the large creeks east of San Francisco Bay.

Ariolimax Californicus Cp. In the dry season these animals crawl down into deep fissures made by the sun in some soils, or hide on the northern exposure of cañons on streams, in cellars, etc., where some can be

found all summer within ten to twenty miles of the coast. At a place near Oakland where the kitchen-refuse of part of the town is dumped, near a swampy spot, they come out in hundreds to feed on the rotten vegetables, etc., emerging about 4 P. M. up to June, when fogs prevailed, but not until sunset in August. A few *L. campestris* inhabit the same spot, but remain in the wet grass only.

A. niger Cp. This, described with *P. Andersonii*, I have since found once near Cypress Point, Monterey, as well as in several places within the range given before. Near Oakland it does not appear until the ground is well soaked with rain, about November, and deposits its eggs in December to February. It does not occur in gardens, but in uncultivated oak-groves on clay lands.

"A. Hemphilli W. G. Binn., lately described from Niles Station, Alameda Co., seems externally only like a pale var. of *A. niger*.

Limax (Amalia) Hewstoni Cp. In our Proceedings IV, p. 151, 1871, I referred to this as "another new species of *Limacidæ*," being uncertain whether it might not be imported, as I found it only in San Francisco. It certainly agrees nearly with the too brief description of *L. Sandwichensis* as well as the figure, in Voyage of the Bonite, II, p. 497, Pl. 28, f. 8, but comparison of living specimens will be necessary. Mr. Binney in Ann. N. Y. Lyc. XI, 22, states that specimens of an *Amalia* were sent to him by Mr. Hemphill from Los Angeles, and though differing in its dentition, thinks it indicates that the genus is native to California. I am more inclined to think some species has also been introduced there with orange trees, grape vines, or otherwise.

My reason is, that I have searched carefully for these animals in Southern California since 1871, and found only *Limax campestris*, which is common near San Buenaventura, and occurs south to San Juan Capistrano, while I found none in the mountains or valleys near San Diego, and no *other* one at Los Angeles.

This species has apparently succeeded in establishing itself in spots on the east side of S. F. Bay, where the climate is much drier than in the city. I have found it only in one very damp garden in Oakland, and in some 12 miles east of there, while outside of cultivated gardens, even where always moist, it does not occur.

Alexia (myosotis var.?) setifer Cp. Since my first notice of this species, it has been nearly exterminated in Mission Creek, by street crossings and obstructing the tidal flow, so that I have lately found it only in one spot near the mouth. It may, however, remain more scattered in Mission Bay, though so exceedingly tender that it has died in every other locality where I have tried to colonize it. The name given in Vol. V, p. 172, as "*Melampus ciliatus*" should be Auricula ciliata *Moricand*.

Ancylus crassus Hald? A specimen received from Humboldt River, Nev., by Dr. Yates, appears to be a thin variety of this, approaching "*A. Kootaniensis*" Baird, and thus connecting the latter with former, as I doubtfully placed them in these Proceedings, IV, 101, 1870.

On p. 174 of same volume, I referred specimens from Spokan River to *A. patelloides* Lea, by mistake for *A. crassus.*

Gundlachia Californica Rowell. Two specimens found by me in a little sandy rivulet at Baulines Bay, appeared to be merely the common *Ancylus fragilis*, but some months after, in taking out the animal, I found that one had a "deck" covering nearly its whole aperture, exactly as in the "young of *G. Stimpsoniana*" figured by S. Smith in the Ann. N. Y. Lyc. May, 1870. The other, though exactly similar above, is an *Ancylus* below! That from Merced Falls, mentioned in our Vol. IV, p. 154, differs in being much smaller and paler, as were the *Ancyli* found with it. Mr. Smith states that the animal of his was exactly like that of *Ancylus fuscus*, and Dr. Stimpson described the dentition as similar also, to that of *A. rivularis*. These facts seem to show that the forms called *Gundlachia* are only modifications of *Ancyli*, analogous to the thickening of lip observed in Physas that survive a winter or a dry season. Some individuals, better nourished than others, secrete so much shell as to nearly enclose themselves in their first year's shell. In the following year they may continue to form shell, and thus make a *two-storied Gundlachia* from a one-storied *Ancylus*. Thus we see why the specimens of the former so much resemble those of the latter found with them, in the respective localities of each so-called species.

Limnophysa Binneyi Tryon. Many specimens of this fine species were found by Mr. Dunn at the Cascades of the Columbia, with a *Physa*, apparently a large var. of *P. diaphana.*

Pomatiopsis intermedia Tryon. Found once near Clear Lake by Dr. Yates, and by me in a small spring near Saucelito, Marin Co., the last proved by the animal.

Bythinella Binneyi Tryon. I have found what I suppose to be this near the summit of "Black Mountain," Santa Clara Co., over 1,500 ft. alt., in a cold mountain rivulet. Others from branches of Alameda Creek found by Dr. Yates, differ entirely in the animal from that of *Pomatiopsis*, but it externally resembles closely that of *Amnicola*, of which this is scarcely more than a subgenus.

Cochliopa Rowellii? Tryon. Two fossil specimens from post-pliocene beds near Green Valley, Contra Costa Co., are so much like this species, as figured, that it may still exist in California, even though found at Panama also, as Mr. Tryon believes, from specimens received. Several Central American fresh-water shells seem to be identical with the northern, and a Tropical American *Pompholyx* is described as closely resembling that of California.

Hydrobia Californica Tryon. After long search I have found specimens of a true *Hydrobia* in a very limited station at the head of a brackish creek on the south side of "Lake Peralta," Oakland, where they occur on floating sticks. The shell described by me in Proc. Acad. Sc. Phil. 1872, as *Assiminea Californica* "Tryon," and mentioned in these Proceedings,

IV, 173, is quite distinct, and inhabits the outlet of the same creek abundantly, ½ mile lower down. They must be distinguished as follows:

A. Californica Cooper (Tryon in part?). Dark horn-brown, shining, acute, whorls rapidly increasing, and flattened on spire, a slight parietal callus, not connecting lips. Animal whitish, tentacles and muzzle tinged black, a rufous patch on top of head, its foot ovate, twice as long as shell; tentacles oculiferous, two.

H. Californica Tryon (emend., figure and part of description). Shell nearly white, translucent, rough, rather obtuse, whorls slowly increasing, and very convex, mouth subovate, lip nearly continuous, leaving a slight notch in umbilical region. Animal white, top of head and tentacles (four) yellowish, a black jaw (?), visible in proboscis. which is very extensible; foot with pointed lateral lobes in front spreading sideways, tapering to a long acute point behind, tentacles long and sharp, the eyes at their base; foot 1½ times the length of shell—proboscis half its length, tentacles about as long.

The animal of *Hydrobia* is much more active than that of the former, and easily observed in a bottle of water taken from its peculiar station.

Regular Meeting, February 15th, 1875.

The President and Vice-Presidents being absent, Mr. Stearns was called to the chair.

Eighteen members present.

Donations to the Museum: From Mrs. F. F. Victor a collection of shells from Modoc Lake, on the northern border of California. Henry Hemphill donated sundry reptiles and crustaceaceæ, (not identified); from W. Russel a mole-cricket; from Dr. Kellogg a specimen of *Pinus muricata* from Santa Cruz, illustrating the enlarged umbos when much exposed to the winds of the coast, also cones of *Pinus monophylla*, one of the most nutritive and delicious of all the piñones. From F. Gruber, the following birds: *Perdix cinerea*, or European Field Partridge; *Ampelis garrulus*, or wax wing; *Alauda brachydactyla*, or Crossbill; *Fringilla Coccothraustes*, or Grosbeak; *Oriolus galba*, or Golden Oriole.

The Secretary read a paper from Professor George Davidson, as follows:

Abrasions of the Coast of Japan.

BY GEORGE DAVIDSON.

In approaching the coast of Japan on the voyage from San Francisco, there is opportunity for seeing but a very few miles near the southern eastern point of the entrance to to the Gulf of Yedo. This we made before daylight, and so far as I could make it out, there was no feature resembling the well marked terraced points and capes met with on the northwest coast of North America.

The surface features of the coast are nevertheless well marked and distinctive, reminding one of parts of the Pacific coast of Mexico, and of parts north of latitude forty, except the absence of the heavily timbered slopes and summits. On the coast of Japan the hills rise steeply to elevations reaching two and three thousand feet, and are either cultivated or covered with a dark green chapparal, with occasional limited masses of small timber. There are no indications of broad deep valleys, but mostly of short narrow valleys with sharply sloped sides.

After entering the Gulf of Yeddo the only terraces I could detect are at Cape Canon, on the western side about twelve miles south of Yokohama, and at a the part of the Gulf where a moderately sharp contraction of the width of the Gulf takes place. At this point are exhibited some of the characteristics of the terraced points off our Pacific Coast. The coast-line is of quite recent formation; the stratification somewhat distorted, and has a moderately large inclination; but the surface of the contracted terraces is parallel with the sea-level, and has evidently been planed off by the Glacier which moved along the face of the sloping higher land. On the surface of these terraces lies a thin layer of soil which is cultivated.

Upon leaving Yokohama for Nagasaki I had another opportunity of examining this terrace and confirming my previous judgment. Thence to Oō Sima, the coast line was passed in the night time until we made Ise Bay, where the high, broken and dark outline of the coast hills is seen. Every hillside is covered with dark green chapparal and small timber; the hills reach two thousand feet elevation and give no indications of extended valleys. Skirting along this coast in moderately thick weather we saw no terraced shores until we neared the promontory off which lies the island of Oō, with its lighthouse, in latitude 32° 25′. Here were unmistakable evidences of terraced coast line, not in one or two cases, but for miles to the northeast of Oō Sima (*a*), and especially in the island itself. The single terrace of this island is very well marked parallel to the sea-level, and is about 100 feet above the water. When abreast of it several slightly projecting terraced points are seen along the coast to the northeastward, and also on the coast immediately abreast of the island. But I did not see the terraced lines along the north-

(*a*) Sima · Island.

west coast line of this promontory, even in the vicinity of Oö Sima. Bad weather and night shut in further opportunity.

This promontory forms the eastern shores to the eastern entrance to the great strait, called the inland sea of Japan, through which we passed for two hundred and fifty miles, enjoying some of the most enchanting views I have ever seen, reminding me forcibly of the great inland waters from Puget Sound to the Chilkaht River, but enlivened by hundreds of junks and fishing vessels; shores lined with villages; steep hillsides terraced for cultivation to heights of nearly one thousand feet, wherein the numerous terrace walls would certainly form a total height of four hundred feet, as I have verified here. Some of the passages are tortuous, narrow and deep—through high islands or between steep fronted capes. Cultivation on every spot where even five hundred square feet and less can be terraced. No heavy timber; sparsely distributed patches of small timber; large growth of chapparal on the higher and steeper parts of the hills. The mountains rise to elevations of probably 3,000 feet, but the average height of the outline will be about one thousand feet. Again no indications of valleys except of the most limited character.

I looked in vain through all these shores for signs of terrace formation. So along the outer coast and through the islands from Simonoseki strait to Nagasaki, the hills preserved their characteristic outlines and shapes, except Table Mountain, fifteen hundred feet high and lying a few miles west of Nagasaki.

Here I have had ample opportunity to judge of the general geological character of the country. It is of the most recent formation, has been violently distorted by pressure from below, and then eroded into its present irregular surface. I have looked occasionally for local traces of glacial action in some of the harder materials, but failed to satisfy myself beyond doubt.

But of the glacial action at Cape Canon, and at Oö Sima, and the adjacent coast, I have no doubt whatever; but in both cases I could trace but one terrace, and that at Oö Sima had an elevation of one hundred feet.

I have communicated this short note to the Academy as an additional evidence to what I have already given of the abrasions of coast line by the action of glaciers bordering them.

The Secretary also read a paper from Professor Davidson, as follows:

Note on the Probable Cause of the Low Temperature of the Depths of the Ocean.

BY GEORGE DAVIDSON.

In my first note upon the "Abrasions of the Continental Shores of Northwest America, and the supposed Ancient Sea Levels," I attributed these abrasions to the action of a great body of ice contiguous to the whole line of our coast, and which moved along the coast line either by the combined forces

of ocean currents and the pressure of the greater masses from the northward; or as part of the great ice sheet that covered the continent and moved slowly southward.

As a glacial mass it extended seaward many miles, as indicated by its action upon the islands which I therein named. And it seems not only possible, but highly probable, that this great ice sheet not only covered and bordered the continent, but that it projected far into the oceans; *and not improbably may have occupied a large part thereof!*

We know its effect in the terracing of the rocky coast of Northwest America; and in cutting the channels through the Santa Barbara Islands; and still further, I believe we see other *effects of its existence and extent in the present nearly ice-cold temperature of the great depths of the ocean!*

The theory which attempts to account for that low temperature by the transfer of Arctic waters to the depths of ocean utterly fails in the case of the Northern Pacific Ocean, where the narrow contracted throat of Behring Strait not only could not give egress to such a volume of cold water in millions of years, but is actually the channel for the passage of the Kamschatka branch of the Japan warm stream into the Arctic basin. A small thread of the Arctic waters does pass through Behring Strait, but it is of very limited section, for the strait itself has a section of only thirty miles in width by twenty-five fathoms in depth.

The more that I have looked at the discussions of the theory of the intercharging heated surface waters of the equatorial regions with the cold waters of the Arctic basin, the more strongly I am convinced of its weakness and insufficiency. And in searching for the cause of the nearly ice cold waters of the ocean depths, the proved former existence of the great ocean coast ice belt, and probably of ice masses occupying the high northern and southern areas of the oceans, have seemed to me sufficient to account for the low temperatures which deep sea explorations have proven to exist.

Dr. Kellogg read a paper describing the different varieties of Eucalyptus, with their characteristics.

Different Varieties of Eucalyptus, and their Characteristics.

(Letter to Mr. Ellwood Cooper, of Santa Barbara.)

BY DR. A. KELLOGG.

According to promise, I collate a few brief notes on *Eucalypti.** As you have Dr. Mueller's work I need not quote from it, but give such information as can be obtained from other sources. For the medical properties of extracts, etc., I refer you to the Doctor.

I wish to say, first, that I know of but *two trees* (which now occur to me) that are perfectly proof against the *Teredo navalis*, or pile-borer of tide water,

* There are one hundred and thirty-five species. A long time may elapse before a thorough knowledge of these and their numerous varieties are fully known.

or their like. These are the Palmetto (*Chamærops palmetto*) of our southern coast, and the Yarrah of Australia. There are doubtless many more. (?)

If at any time you visit the city, we shall take great pleasure in showing specimens of timber that have been tested, now in the collection of the California Academy of Sciences (of which your correspondent is Director in charge). So that no one need take second-hand opinions, or the *Ipse dixit* of any one writer, author, or personal friend. This much is due, by way of introduction. And further, we need to be cautioned against considering that any one knows it all. Much experience and careful experiment is yet requisite; I trust, however, that thorough tests of all timbers, native and cultivated, will, ere long, be made, either at our State University or the Academy.

If I am right, the common *Eucalyptus globulus* (of which you cultivate so much) is not an Australian Gum at all, but Tasmanian—New Zealand has none; if wrong in this impression, I will write again. *E. globulus* is greatly infested by beetle borers when transplanted into parks in Australia. We have a specimen badly eaten by the *Teredo*, but the card attached omits to name the species.

E. rostrata.—This is the famous Yarrah (or by corruption, Jarrah of some. It should be noted that this name is applied by the natives, and vulgarly, to almost any tree). This specimen is also called Flooded Gum, Red Gum, or White Gum—described as a striking object on the landscape—so wild and picturesque; its huge, gnarled or coiled branches—shining bark of white or light red—contrasting with dark masses of foliage above, and glancing shadows below, produce peculiar scenic effects of the wildest forests, awakening the ideas of grandeur, as the lofty object lifts its signal flags high over all the trees; inspiriting the thirsty, weary and worn traveller from afar with the living assurances of water.

This is the true species that has proven so perfectly proof against the white ant and beetle borers; and altogether impervious to the *Teredo* that infests the piles of our wharves. A specimen of this timber, presented by Mr. I. C. Woods of this city, has stood the best of actual trial, as here seen.

This is also largely used for railway ties, etc. The wood is solid as iron; specific gravity 0.858 to 0.923 or variable, and does not always bear so good a character—climate, soil, etc., have much to do with the quality of this and all timber, as we know full well. A large tree, along streams or adjacent to water.

E. tereticornis.—Called Gray Gum, often Red Gum or Blue Gum, and sometimes Bastard Box—a very variable species. Flowers generally seven in a cluster; seed box has a broad rim, the valves protruding. The wood is good for posts and rails, or as fuel—has a beautiful grain like oak—takes a fine polish, and whether exposed or not is durable. Used where the Iron Bark cannot be had.

E. punctata.—This is mostly termed Hickory or Leather Jacket; has rather spreading habit; is exceedingly tough and durable; fine for fencing, railway sleepers, and for fuel. The rim of this seed-vessel is not so broad, nor valves so prominent; there are several varieties.

E. Stuartiana var. *longifolia*, is the Yellow Gum; seldom 80 feet high; timber good; leaves very long; valves of seed-vessel not so prominent as the preceding;

wood only used for fencing or fuel; decays rapidly if exposed; easily killed by a wet season.

E. viminalis.—This is the Manna; also Drooping; called also White Gum; yields manna, and is *remarkable for its elegance;* 150 feet high, 8 feet diameter; not much esteemed. The Gray Gum (*E. saligna*) sometimes mistaken for this, etc.

E. dealbata is one of the so-called White Gums, about 50 feet, without branches, capped with dense foliage, covered with a white powdery bloom (easily rubbed off); bark of a purplish tinge when young, becoming brown with age; wood light color, too soft to be of general use; said to shed its bark every third year.

E. albens is also one of the White Gums; 80 feet high, etc.; wood of little or no use.

E. goniocalyx is one of the most useful; in some districts called Flooded Gum; in others, Blue Gum; chiefly found on rivers and creeks, and is also a forest tree. One mark of this species is the angular calyx—hence specific name; another, the short, flat peduncles (flower-stems) in umbels or clusters of seven flowers on short, thick stems; 80 feet or more, 7 feet diameter. Although the wood varies with soil, it is generally considered highly valuable; several of the Blue Gums of catalogues belong to this species; a tree of rapid growth; specific gravity less than that of any other Gum. The timber is extensively used for building purposes, as scantling, battens, floors, posts and rails, ship's planks, etc. Indicates good soil.

E. dumosa—the big chaparral bush so annoying to travelers.

E. incrassata is another of the small species that together constitute the Mallee Scrub; the natives sharpen and harden in hot embers for digger sticks, like metal; famous for ramrods, etc.

E. uncinata is Dr. Mueller's *E. oleosa*—still another of the above list of Mallee Scrub; the root runners retain a copious supply of pure water for the thirsty.

E. hæmastoma—Mostly known as White Gum, but in some districts the bark has gray patches; hence known as Spotted Gum; little esteemed for fuel or any other use.

E. stellulata—This is the Mountain White Gum; in some districts the bark is lead-colored, hence named Lead Gum; 30 to 40 feet high, and 2 feet diameter; wood of no service, save for fuel; distinguished by veins or nerves that start near the base of the leaves, and run almost parallel to the midrib.

E. coriacea—This is another of White Gums from the Blue Mountains; 40 to 80 feet; not much valued.

E. radiata—The River White Gum (by some considered a variety of the Messmate or *E. amygdalina*). This is a smooth tree with bark often hanging in long strips from the upper branches; it never grows away from water; 50 to 60 feet; timber not valued by the settler.

E. eugenioides—The Mountain Blue Gum; 100 feet high, and much used by wheelwrights and carpenters, but is not equal to *E. goniocalyx*, the Flooded or Blue Gum.

E. gracilis is Dr. Mueller's *E. fruticetorum*; a small tree or shrub of several varieties.

E. Saligna a Gray or Flooded Gum of rather drooping habit and no great size; in low grounds, *near salt water;* although a fine looking tree, sometimes 100 feet in height, the wood is inferior.

E. maculata or Spotted Gum is one of the handsomest; 100 feet and upwards; well defined by its double lid and urn-shaped seed-vessel; some esteem it equal to the English oak, others regard it as fire-wood; used for staves and upper parts of railroad bridges, etc.; grows in poor soils, New South Wales and South Queensland.

E. virgata—Styled Mount Ash (this name, I see, is given to *E. amygdalina* or Messmate in the Government Report of the Secretary for Agriculture of 1874). This is a fine tree, 120 feet high, growing on rocky mountain ridges; makes better staves, good shafts, and all common carpenter work, fences, etc.

E. obtusiflora—An inferior kind of Box or Blackbut; has large flowers, and an ovid blunt seed-vessel; the wood is valueless.

E. pilularis or Blackbut of South Queensland, Gipps Land and New South Wales, is one of the largest and most valuable species of the Gums. A tree of over 46 feet circumference 5 feet from the butt; 150 to the first limb. The wood is excellent for house carpentry, ship building, and, indeed, for any purpose where strength and durability are required; specific gravity 0.897: no species known bears a greater crushing strain in the direction of its fibre; it prefers good soil, and grows rapidly.

E. acmenoides, or White Mahogany, is remotely allied to the above.

E. Bicolor comprises several varieties, called Bastard Box or Yellow Box; this resembles the narrow-leaved variety of Iron Bark; has grey and white patches, hence the specific name; 80 to 100 feet high; when young, smooth above, or half-barked like the Box; older, nearly all the bark falls off; the wood is very hard, good for fencing, shafts, poles, cogs, etc.; exceedingly durable; heavy, but does not split well; as it does not sun-crack, it is esteemed for spokes, weather boards, etc.

E. hemiphloia is the well-known Box. In first-class repute for hardness, toughness and durability; burns brilliantly, and emits great heat, but it is attacked in the ground by dry rot and the white ant; specific gravity, 1.129; shafts, spokes, plough-beams, etc.

E. longifolia, usually called Wooleybut, though in some districts called Peppermint,* on account of the oil of the leaves having that flavor. A very fine tree, with leaves more than a foot long; flowers large, in 3s; seed-vessels best defined of all, ¾ inch long, ½ in diameter, four-celled, valves not protruding beyond the broad oblique rim. The volatile oil of the leaves possess remarkable qualities, but the wood is not much esteemed, save as fuel; it is, however, split for fencing and the like, but not durable; others say excellent; the fibre of the bark is adapted for packing and paper making.

E. diversifolia—A tree of beautiful form, 80 feet high; wood indifferent; buds and seed-vessels small, eight, in axillary or lateral umbels.

E. polyanthemos is a tree of moderate size called *Lignum Vitæ*, Poplar-leaved Gum, or Bastard Box; wood brown towards the centre; very hard and tough.

E. pulverulenta and *E. cinerea*—Two varieties of small tree called Argyle Apple (being similar to *Angophora subvelutina*, or Apple of the Colonists).

E. acmenioides or the White Mahogany; often mistaken for the Stringy Bark (*E. obliqua*, capitella, etc.), but the bark is not so fibrous, nor the leaves so oblique, whilst the specific gravity of the wood is much greater; found near the coast; timber useful for building purposes, palings, etc.; when nicely planed, has an ornamental appearance.

E. robusta is the Swamp Mahogany, a very large tree; over 100 feet, and 5 diameter; in low marshy places; seed-vessel more than one-half an inch long, the capsule deeply sunk; in young trees the leaves are large and glossy. The wood is not considered durable, though people differ in opinion; used for rough furniture and inside work, ship-building, wheelwrights, and for mallets, etc.

E. botryoides is the Bastard Mahogany of workmen; it grows in sandy places near the sea. A tree of gnarled and crooked growth of no great height; used for fuel, knees, etc., of vessels.

E. resinifera, often called Red and Forest Mahogany; the first name is taken from the color of the wood, the other from being found in forests remote from the coast. The wood is very strong and durable, and is used extensively for fencing, beams, rafters and rough work; specimens of sound wood that had been fifty-four years in a church were taken down and sent to the Paris Exposition.

E. corymbosa, or Bloodwood, from the color of the resin that exudes from between the concentric circles; inland species; 120 feet; for fences and firewood; of rapid growth; the wood is soft, especially in young trees; becomes

* This we take to be the far-famed fire-proof shingle tree; sparks can only burn a hole through, but it will neither flame nor spread; splits to a charm.

harder in age; said to stand well in damp ground; some affirm its great strength and durability; seeds winged.

E. eximia is the Mountain Bloodwood; Bentham thought this species more nearly allied to *E. maculata* or Spotted Gum than to Bloodwood; flowers large, corymbose; the operculum or lid is double, the seed-vessel is urn-shaped, nearly an inch long; top of capsule deeply sunk.

E. stricta is a shrubby species; fine linear leaves; forms thick brushes; it is the *E. microphylla* of Cunningham.

*E. dives** and *E. piperita* are two of the Peppermints; the first has small, and often opposite leaves; the latter very large, like a Stringy Bark, but not so thick, nor are they so oblique at the base; flower-buds smaller; lid more hemispherical and sharper at the point, whilst the seed-vessel is more globose; but they vary from Mountain Ash (*E. radiata*) in bark and habit; 5 to 15 feet diameter; 200 feet of clear shaft, etc.

E. melliodora, the Red Flowering or Black Iron Bark; flowers ornamental; delicious honey-like odor, as the name indicates; 60 feet; timber in quality variable.

E. panniculata, and *E. cerebra* (one species), are mere varieties of the White Iron Bark, one of the most valuable trees; specific gravity, 1.016; the breaking weight of a transverse strain of a beam four feet between bearings 1⅞ square, 4,519 lbs.; best of all the Iron Barks; a smooth, uniform outer bark; hard, tough, inlocked strong wood; highly esteemed by coach-makers and wheelwrights for poles, shafts, etc., of carriages, spokes of wheels; also largely for piles and railway sleepers; 150 feet high by 16 feet diameter; both of these are united into one species.

E. siderophloia is the Red or Large-leaved Iron Bark, formerly described as *E. resinifera*; this yields the brown gum or Botany Bay Kino (inspissated juice). The wood though not so tough as the preceding, is considered one of the strongest and most durable of timbers. There are two varieties; both vary from 80 to 120 feet, distinguished by the bark, which is darker color than the *E. panniculata* or White Iron Bark, and the leaves are more uniformly larger.

E. melanophloia is the Silver-leaved or Broad-leaved Iron Bark; a taller tree than the other Iron Barks, and readily known by its stemless or sessile opposite leaves, which are glaucous or mealy white.

E. obliqua, *E. capitella* and *E. macrorhyncha*—Hon. Wm. Woolls, F. L. S. (from whom we collate), considers them all as forms of the Stringy Bark, only varying with climate, soil, elevation or proximity to the sea, etc.; rises to 100

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*It is possible this may be the *Shingle tree* (?) of a previous note.

or 120 feet; some of these woods are reported as excellent for house-carpentry, whilst others were inferior; 300 to 400 feet high; the bark makes packing, printing, and even writing paper; also good for mill and paste-boards; the pulp bleaches readily; forms the main mass of forests of the more barren mountains; the thick bark has also been successfully manufactured into door-mats, cheap fences, palings, shingles and wood-work.

E. amygdalina or Almond-leaved Eucalyptus, or Messmate, is like the Stringy Bark, but the upper branches are smooth; 200 feet high; wood not much valued; a hard tree for the settlers to kill, it is so irregular at the base; wood folded or deeply indented, forming clefts or "pockets" so that they cannot ring, belt or girdle the tree to advantage, for they fail to reach all the bark of these hollows. In the Messmate the leaves are not so thick as in the Stringy Bark, nor are they so oblique at the base; flower-buds are smaller; lid more hemispherical, and its point sharper, whilst the seed-vessel is more globose; but they vary from *E. radiata* in bark and habit; 5 to 15 feet diameter, with 200 feet of clean shaft.

Dr. Mueller's scientific work abounds in varied information; but collations from that work are omitted to avoid repetition. For medical and manifold uses see his work.

P. S.—As Dr. Mueller's "Additions to the List of Principal Timber Trees, etc." (Issued 1871-2, by the Victorian Acclimatization Society) is not accessible to many, we extract the following:

E. botryoides, Smith. From East Gipps Land to South Queensland. One of the most stately among many species, remarkable for its dark green shady foliage. It delights on river banks—80 feet without a branch, diameter of 8 feet. Timber usually sound to the center; water work, wagons, knees of boats, etc., for posts very lasting, as no decay was observed in 14 years.

E. brachypoda, Turc. Widely dispersed over the most arid tropical and extra-tropical inland regions of Australia. One of the best trees for desert tracts; in favorable places 150 feet high. Wood brown, sometimes very dark, hard, heavy and elastic, prettily marked, used for cabinet work, but more particularly for piles, bridges and railway sleepers. (Rev. Dr. Woolls).

E. calophylla, R. Brown. S. W. Australia. More umbrageous than most Eucalypti, and of comparatively rapid growth. The wood is free of resin when grown on alluvial land, but not so when produced on stony ranges. Preferred to *E. marginata* and *E. cornuta* for rafters, spokes and fence-rails—strong and light but not lasting long underground. Bark valuable for tanning, as an admixture to *Acacia* bark.

E. cornuta. S. W. Australia. A large tree of rapid growth, prefers a somewhat humid soil. Used for various artizan work, preferred for strongest shafts and frames of carts, and work requiring hardness, toughness and elasticity.

E. crebra, F. V. Mueller. The narrow-leaved Iron Bark of N. S. Wales and Queensland. Wood reddish, hard, heavy, elastic and durable; for bridges much in use, also for wagons, piles, fencing, etc. *E. melanophoia*, (F. V. M.) the silver-leaved Iron Bark; *E. leptophleba: E. trachyphloia* and *E. drepanphylla* are closely allied species of similiar value. They all exude astringent gum-resin in considerable quantity, like Kino in appearance and property.

E. Doratoxylon, F. V. M. The spearwood of S. W. Australia. In sterile districts. The stem is slender and remarkably straight, wood firm and elastic; nomadic natives wander far to obtain it for their spears.

E. eugenioides, S. N. S. Wales. Regarded by the Rev. Dr. Woolls as a fully distinct species. Its splendid wood, there often called Blue Gum tree wood, available for many purposes, and largely utilized for ship building.

E. goniocalyx, F. V. M. From Cape Otway to the southern parts of N. S. Wales. A large tree, which should be included among those for new plantations. Its wood resembles in many respects that of *E. globulus*, proved a valuable timber for house building, fence rails, etc.

E. Gunnii, J. Hook. At Alpine and sub-Alpine elevations.

The other more hardy Eucalypts comprise *E. coriacea*, *E. E. alpina*, *urnigera*, *E. coccifera*, and *E. vernicosa*, which all reach heights covered with snow for several months in the year.

E. Leucoxylon, F. V. M. (*E. sideroxylon*, syn.) The common Iron bark of Victoria. Some parts of S. Australia and N. S. Wales. As this durable timber is falling short, and for some purposes superior to almost any other Eucalypt, its culture should be fostered, especially as it can be raised on stony ridges of little use. The wood is pale, sometimes dark. The tree restricted generally to the lower silurian sandstone and slate, with ironstone and quartz. It is rich in Kino.

E. Phœnicea, F. V. M. Little is known of the timber, but the brilliancy of its scarlet flowers should commend it to extensive culture. For the same reason also *E. miniata* from North Australia, and *E. ficifolia* from S. W. Australia. Carpenteria and Arnheim's Land.

E. platyphylla, F. V. M. Queensland. One of the best shade trees. Rev. Mr. Woods saw leaves 1½ long by 1 foot wide. Thrives in open or exposed localities.

E. tesselaris, F. V. M. N. Australia and Queensland. Furnishes a brown, rather elastic wood, not very hard, available for varied artizan work, staves, flooring, etc. Exudes much astringent gum-resin.

Mr. Stearns made some verbal remarks concerning Dr. Kellogg's paper, and mentioned the proper and improper methods of transplanting the young trees.

Mr. Stearns also called the attention of the Academy to the peculiarities of certain young trout in the hatching troughs at Berkeley. Some of the fish which were hatched from eggs brought from the Eastern States by rail, were double—some two heads and one tail, and others were distinctly formed but joined together by a filmy substance.

A letter was read from Prof. D. C. Gilman, President of the University of California, inviting the members of the Academy to hold a session at Berkeley on Monday, February 22d.

The invitation was accepted, and the Academy adjourned to meet at Berkeley on Monday, February 22d, at 11 A. M.

SPECIAL MEETING AT BERKELEY, FEBRUARY 22d, 1875.

Henry G. Hanks in the Chair.

Mr. Stearns, in behalf of the Academy, made some remarks to those present, reminding the members that the Academy must depend mainly upon the University to fill its ranks as time thinned it of its pioneers.

Professor Joseph LeConte read the following paper, the result of original investigations near Lake Tahoe:

On some of the Ancient Glaciers of the Sierra.

BY JOSEPH LE CONTE,

Professor of Geology of the University of California.

II.—SOME OF THE TRIBUTARIES OF LAKE VALLEY GLACIER.

Last summer I had again an opportunity of examining the pathways of some of the ancient glaciers of the Sierra. It will be remembered, by those interested in this subject, that two years ago I published a paper with the above title.* One of the grandest of the glaciers there mentioned was one

*Am. Journal, Ser. III, Vol. 5, p. 125. Proc. Cal. Acad. Sciences, Vol. IV, part 5, p. 259.

which I called *Lake Valley Glacier*. Taking its rise in snow fountains amongst the high peaks in the neighborhood of Silver Mountain, this great glacier flowed northwards down Lake Valley, and gathering tributaries from the summit ridges on either side of the valley, but especially from the higher western summits, it filled the basin of Lake Tahoe, forming a great mer de glace, 50 miles long, 15 miles wide, and at least 2,000 feet deep, and finally escaped northeastward to the plains. The outlets of this great mer de glace are yet imperfectly known. A part of the ice certainly escaped by Truckee Cañon, (the present outlet of the lake); a part probably went over the northeastern margin of the basin. My studies during the summer were confined to some of the larger tributaries of this great glacier.

Truckee Cañon and Donner Lake Glaciers.—I have said that one of the outlets of the great mer de glace was by the Truckee River Cañon. The stage road to Lake Tahoe runs in this cañon for fifteen miles. In most parts of the cañon the rocks are volcanic and crumbling, and therefore ill adapted to retain glacial marks; yet in some places where the rock is harder these marks are unmistakable. On my way to and from Lake Tahoe, I observed that the Truckee Cañon glacier was joined at the town of Truckee by a short but powerful tributary, which, taking its rise in an immense rocky amphitheater surrounding the head of Donner Lake, flowed eastward. Donner Lake, which occupies the lower portion of this amphitheater, was evidently formed by the down-flowing of the ice from the steep slopes of the upper portion near the *summit*. The stage road from Truckee to the summit runs along the base of a *moraine* close by the margin of the lake on one side, while on the other side, along the apparently almost perpendicular rocky face of the amphitheater, 1,000 feet above the surface of the lake, the Central Pacific Railroad winds its fearful way to the same place. In the upper portion of this amphitheater large patches of snow still remain unmelted during the summer.

My examination of these two glaciers, however, was very cursory. I hasten on, therefore, to others which I traced more carefully.

As already stated in my former paper, Lake Tahoe lies countersunk on the very top of the Sierra. This great range is here divided into two summit ridges, between which lies a trough 50 miles long, 20 miles wide, and 3,000–3,500 feet deep. This trough is Lake Valley. Its lower half is filled with the waters of Lake Tahoe. The area of this lake is about 250 square miles, its depth 1,640 feet, and its altitude 6,200 feet. It is certain that during the fullness of glacial times this trough was a great mer de glace, receiving tributaries from all directions except the north. But as the glacial epoch waned—as the great mer de glace dwindled and melted away, and the lake basin became occupied by water instead, the tributaries still remained as separate glaciers flowing into the lake. The tracks of these lingering smaller glaciers are far more easily traced, and their records far more easily read, than are those of the greater but more ancient glacier of which they were but once the tributaries.

Of the two summit ridges mentioned above, the western is the higher. It bears the most snow *now*, and in glacial times gave origin to the grandest

glaciers. Again: the peaks on both these summits rise higher and higher as we go toward the upper or southern end of the lake. Hence the largest glaciers ran into the lake at its *southwestern* end. And, since the mountain slopes here are towards the northeast and therefore the shadiest and coolest, here also the glaciers have had the greatest vitality and lived the longest, and have, therefore, left the plainest record. Doubtless, careful examination would discover the pathways of glaciers running into the lake from the eastern summits also; but I failed to detect any very clear traces of such, either on the eastern or on the northern portion of the western side of the lake; while between the southwestern end and Sugar Pine Point, a distance of only eight or ten miles, I saw distinctly the pathways of five or six. North of Sugar Pine Point there are also several. *They are all marked by moraine ridges running down from the summits and projecting as points into the lake.* The pathways of three of these glaciers I studied somewhat carefully, and after a few preliminary remarks, will describe in some detail.

Mountains are the culminating points of the scenic grandeur and beauty of the earth. They are so, because they are also the culminating points of all geological agencies—igneous agencies in mountain *formation*, aqueous agencies in mountain *sculpture*. Now, I have already said that the mountain peaks which stand above the lake on every side, are highest at the southwestern end, where they rise to the altitude of 3,000 feet above the lake surface, or between 9,000 and 10,000 feet above the sea. Here, therefore, ran in the greatest glaciers, here we find the profoundest glacial sculpturings, and here also are clustered all the finest beauties of this the most beautiful of mountain lakes. I need only name Mt. Tallac, Fallen Leaf Lake, Cascade Lake, and Emerald Bay, all within three or four miles of each other and of the Tallac House. These three exquisite little lakes, (the Emerald Bay is also almost a lake) nestled closely against the loftiest peaks of the western summit ridge, are all perfect examples of glacial lakes.

South of Lake Tahoe, Lake Valley extends for fifteen miles as a plain, gently rising southward. At its lower end it is but a few feet above the lake surface, covered with glacial drift modified by water, and diversified, especially on its western side, by débris ridges, the moraines of glaciers which continued to flow into the valley or into the lake long after the main glacier, of which they were once tributaries, had dried up. On approaching the south end of the lake by steamer, I had observed these long ridges, divined their meaning, and determined on a closer acquaintance. While staying at the Tallac House I repeatedly visited them, and explored the cañons down which their materials were brought. I proceed to describe them.

Fallen Leaf Lake Glacier.—Fallen Leaf Lake (see map) lies on the plain of Lake Valley, about one a half miles from Lake Tahoe, its surface but a few feet above the level of the latter lake, but its bottom far, probably several hundred feet, below that level. It is about three to three and one-half miles long and one and one-fourth miles wide. From its upper end runs a cañon bordered on either side by the highest peaks in this region. The rocky walls of this cañon terminate on the east side at the head of the lake, but on the west side, a little further down. The lake is bordered on each side by an

admirably marked débris ridge (moraines) three hundred feet high, four miles long, and one and one-half to two miles apart. These moraines may be traced back to the termination of the rocky ridges which bound the cañon. On the one side the moraine lies wholly on the plain; on the other side its upper part lies against the slope of Mt. Tallac. Near the lower end of the lake a somewhat obscure branch ridge comes off from each main ridge, and curving around they form an imperfect terminal moraine, through which the outlet of the lake breaks its way.

On ascending the cañon the glaciation is very conspicuous, and becomes more and more splendid at every step. From Soda Springs (map s. s.) upwards, it is the most beautiful I have ever seen. In some places, for many acres in extent, the whole rocky bottom of the cañon is smooth and polished, and gently undulating, like the surface of a glassy but billowy sea. The glaciation is distinct, also, up the sides of the cañon 1,000 feet above its floor.

There can be no doubt, therefore, that a glacier once came down this cañon, filling it 1,000 feet deep, scooped out Fallen Leaf Lake just where it struck the plain and changed its angle of slope, and pushed its snout four miles out on the level plain, nearly to the present shores of Lake Tahoe, dropping its débris on either side, and thus forming a bed for itself. In its subsequent retreat it seems to have rested its snout some time at the lower end of Fallen Leaf Lake, and accumulated there an imperfect terminal moraine. The outlines of this little lake, with its bordering moraines, are shown in the diagram map.

2. *Cascade Lake Glacier.*—Cascade Lake, like Fallen Leaf Lake, is about one and one-half miles from Lake Tahoe, but, unlike Fallen Leaf Lake, its discharge creek has considerable fall, and the lake surface is, therefore, probably 100 feet above the level of the greater lake. On either side of this creek, from the very border of Lake Tahoe, runs a moraine ridge up to the lake, and thence close along each side of the lake up to the rocky points which terminate the true mountain cañon above the head of the lake. I have never anywhere seen more perfectly defined moraines. I climbed over the larger western moraine and found that it is partly merged into the eastern moraine of Emerald Bay to form a medial at least 300 feet high, and of great breadth, (see map.) From the surface of the little lake, the curving branches of the main moraine, meeting below the lake to form a terminal moraine, are very distinct. At the head of the lake there is a perpendicular cliff over which the river precipitates itself, forming a very pretty cascade of 100 feet or more. On ascending the cañon above the head of the lake, for several miles, I found, everywhere, over the lip of the precipice, over the whole floor of the cañon, and up the sides 1,000 feet or more, the most perfect glaciation.

There cannot be, therefore, the slightest doubt that this also is the pathway of a glacier which once ran into Lake Tahoe. After coming down its steep rocky bed, this glacier precipitated itself over the cliff, scooped out the lake at its foot, and then ran on until it bathed its snout in the waters of Lake Tahoe, and probably formed icebergs there. In its subsequent retreat it seems to have dropped more débris in its path, and formed a more perfect terminal moraine than did Fallen Leaf Lake Glacier.

Emerald Bay Glacier.—All that I have said of Fallen Leaf Lake and Cascade Lake, apply, almost word for word, to Emerald Bay. This beautiful bay, almost a lake, has also been formed by a glacier. It also is bounded on either side by moraines, which run down to and even project into Lake Tahoe, and may be traced up to the rocky points which form the mouth of the cañon at the head of the bay. Its eastern moraine, as already stated, is partly merged into the western moraine of Cascade Lake, to form a huge medial moraine. Its western moraine lies partly against a rocky ridge which runs down to Lake Tahoe to form Rubicon Point. At the head of the bay, as at the head of Cascade Lake, there is a cliff about 100 feet high, over which the river precipitates itself and forms a beautiful cascade. Over the lip of this cliff, and in the bed of the cañon above, and up the sides of the cliff-like walls, 1,000 feet or more, the most perfect glaciation is found. The only difference between this glacier and the two preceding is, that it ran more deeply into the main lake and the deposits dropped in its retreat did not rise high enough to cut off its little rock basin from that lake, but exists now only as a *shallow bar* at the mouth of the bay. This bar consists of *true moraine matter*, i. e., intermingled boulders and sand, which may be examined through the exquisitely transparent water almost as perfectly as if no water were present. Some of the boulders are of large size.

All that I have described separately and in detail, and much more, may be taken in at one view from the top of Mt. Tallac. From this peak nearly the whole course of these three glaciers, their fountain amphitheaters, their cañon beds, and their lakes enclosed between their moraine arms, may be seen at once. The view from this peak is certainly one of the finest I have ever seen. Less grand and diversified in mountain forms than many from peaks above the Yosemite, it has the added beauty of extensive water surface, and the added interest of several glacial pathways in a limited space. The observer sits on the very edge of the fountain amphitheaters still holding large masses of snow: immediately below, almost at his feet, lie glistening, gem-like, in dark, rocky setting, the three exquisite little lakes; on either side of these, embracing and protecting them, stretch out the moraine arms, reaching toward and directing the eye to the great lake, which lies, map-like, with all its sinuous outlines perfectly distinct, even to its extreme northern end, twenty-five to thirty miles away. As the eye sweeps again up the cañon-beds, little lakes, glacier-scooped rock basins, filled with ice-cold water, flash in the sunlight on every side. Twelve or fifteen of these may be seen.

From appropriate positions on the surface of Lake Tahoe, also, all the moraine ridges are beautifully seen at once, but the glacial lakes and the cañon-beds, of course, cannot be seen. I have attempted, in the rough sketch accompanying this paper, to express the combined results of observations from many points. The outlines of the great and small lakes are accurate, as these have been taken from reliable maps. Also the general position of the rocky points, and the moraine ridges, are tolerably correct. But, otherwise, the sketch is intended as an illustrative diagram rather than a topographical map. The view is supposed to be taken from an elevated position above the lake surface, looking southward.

There are several questions of a general nature suggested by my examination of these three glacial pathways, which I have thought best to consider separately.

a. *Evidences of the existence of the Great Lake Valley Glacier.*—In my former paper I have already given some evidence of the former existence of this glacier in the glacial forms detectable in the upper part of this valley. I will now give some additional evidence gathered last summer.

On the south shore of Lake Tahoe, and especially at the northern or lower end of Fallen Leaf Lake, I found many pebbles and some large boulders of a beautifully striped, agate-like slate. The stripes consisted of alternate bands, of black and translucent white, the latter weathering into milk white, or yellowish, or reddish. It was perfectly evident that these fragments were brought down from the cañon above Fallen Leaf Lake. On ascending this cañon I easily found the parent rock of these pebbles and boulders. It is a powerful outcropping ledge of beautifully striped silicious slate, full of fissures and joints, and easily broken into blocks of all sizes, crossing the cañon about a half mile above the lake. This rock is so peculiar and so easily identified that its fragments become an admirable index of the extent of the glacial transportation. I have, myself, traced these pebbles only a little way along the western shores of the great lake, as my observations were principally confined to this part; but I learn from my brother, Professor John Le Conte, and from Mr. John Muir, both of whom have examined the pebbles I brought home, that precisely similar fragments are found in great abundance all along the western shore from Sugar Pine Point northward, and especially on the extreme northwestern shore nearly thirty miles from their source. I have visited the eastern shore of the lake somewhat more extensively than the western, and nowhere did I see similar pebbles. Mr. Muir, who has walked around the lake, tells me that they do not occur on the eastern shore. We have, then, in the distribution of these pebbles, demonstrative evidence of the fact that Fallen Leaf Lake glacier was once a tributary of a much greater glacier which filled Lake Tahoe.

The only other agency to which we could attribute this transportation, is that of shore ice and icebergs, which probably did once exist on Lake Tahoe; but the limitation of the pebbles to the western, and especially the northwestern shores, is in exact accordance with the laws of glacial transportation, but contrary to those of floating ice transportation—for lake ice is carried only by winds, and would, therefore, deposit equally on all shores.

Again: I think I find additional evidence of a Lake Tahoe mer de glace in the contrasted character of the northern and southern shores of this lake.

All the little glacial lakes described above are deep at the upper end and shallow at the lower end. Further: all of them have a sand beach and a sand flat at the upper end, and great boulders thickly scattered in the shallow water, and along the shore at the lower end. These facts are easily explained, if we remember that while the glacial *scooping* was principally at the upper end, the glacial *droopings* were principally at the lower end. And further: that while the *glacial* deposit was principally at the lower end, the *river* deposit, since the glacial epoch, has been wholly at the upper end.

Now the great lake, also, has a similar structure. It also has a beautiful sand and gravel beach all along its upper shore, and a sand flat extending above it; while at its lower, or northern end, thickly strewed in the shallow water, and along the shore line, and some distance above the shore line, are found in great abundance *boulders of enormous size*. May we not conclude that similar effects have been produced by similar causes—that these huge boulders were dropped by the great glacier at its lower end? Similar boulders are also found along the northern portion of the eastern shore, because the principal flow of the ice-current was from the southwest, and in the fullness of glacial times the principal exit was over the northeastern lip of the basin.

b. Origin of Lake Tahoe.—That Lake Tahoe was once wholly occupied by ice, I think, is certain, but that it was scooped out by Lake Valley glacier is perhaps more doubtful. All other Sierra lakes which I have seen certainly owe their origin to glacial agency. Neither do I think we should be staggered by the size or enormous depth of this lake. Yet, from its position, it may be a plication-hollow, or a trough produced by the formation of two parallel mountain ridges, and afterwards modified by glacial agency, instead of a pure glacial-scooped rock-basin. In other words, Lake Valley, with its two summit ridges, *may well be regarded as a phenomena belonging to the order of mountain-formation and not to the order of mountain sculpture.* I believe an examination of the rocks of the two summit ridges would probably settle this. In the absence of more light than I now have, I will not hazard an opinion.

c. Passage of slate into granite.—From the commencement of the rocky cañon at the head of Fallen Leaf Lake, and up for about two miles, the cañon walls and bed are composed of *slate*. The slate, however, becomes more and more metamorphic as we go up, until it passes into what might be called *trap*. In some places it looks like *diorite*, and in others like *porphyry*. I saw no evidence, however, of any outburst. This latter rock passes somewhat more rapidly into *granite* at Soda Springs. From this point the cañon bed and lower walls are granite, but the highest peaks are still a dark, splintery, metamorphic slate. The glacial erosion has here cut through the slate and bitten deep into the underlying granite. The passage from slate through porphyritic diorite into granite, may, I think, be best explained by increasing degree of metamorphism, and at the same time a change of the original sediments at this point, granite being the last term of metamorphism of pure clays, or clayey sandstones, while bedded diorites are similarly formed from ferruginous and calcareous slates. Just at the junction of the harder and tougher granite with the softer and more jointed slates, occur, as might be expected, cascades in the river. It is probable that the cascades at the head of Cascade Lake and Emerald Bay mark, also, the junction of the granite with the slate—only the junction here is covered with débris. Just at the same junction, in Fallen Leaf Lake Cañon, burst out the waters of Soda Springs, highly charged with bicarbonates of iron and soda.

d. Glacial Deltas.—I have stated that the moraines of Cascade Lake and Emerald Bay glaciers run down to the margin of Lake Tahoe. An examination of this portion of the lake shore shows that *they ran far into the lake*—

that the lake has filled in two or three miles by glacial débris. On the east margin of Lake Tahoe, the water, close along the shore, is comparatively shallow, the shore rocky, and along the shore-line, above and below water, are scattered great boulders, probably dropped by the main glacier. But on the west margin of the lake the shore-line is composed wholly of moraine matter, the water very deep close to shore, and the bottom composed of precisely similar moraine matter. In rowing along the shore, I found that the exquisite ultramariné blue of the deep water extends to within 100–150 feet of the shore-line. At this distance, the bottom could barely be seen. Judging from the experiments of my brother, Professor John Le Conte, according to which a white object could be seen at a depth of 115 feet, I suppose the depth along the line of junction of the ultramarine blue and the emerald green water, is at least 100 feet. The slope of the bottom is, therefore, nearly, or quite, 45°. It seems, in fact, a direct continuation beneath the water of the moraine slope. The materials, also, which may be examined with ease through the wonderfully transparent water, are exactly the same as that composing the moraine, viz: earth, pebbles, and boulders of all sizes, some of them of enormous dimensions. It seems almost certain that *the margin of the great Lake Valley glacier, and of the lake itself when this glacier had melted and the tributaries first began to run into the lake, was the series of rocky points at the head of the three little lakes, about three or four miles back from the present margin of the main lake; and that all lakeward from these points has been filled in and made land by the action of the three glaciers described.* At that time Rubicon Point was a rocky promontory, projecting far into the lake, beyond which was another wide bay, which has been similarly filled in by débris brought down by glaciers north of this point. The long moraines of these glaciers are plainly visible from the lake surface; but I have not examined them. Thus, all the land, for three or four miles back from the lake-margin, both north and south of Rubicon Point, is composed of *confluent glacial deltas*, and on these deltas the moraine ridges are the *natural levées* of these ice-streams

e. Parallel Moraines.—The moraines described above are peculiar and almost unique. Nowhere, except about Lake Tahoe and near Lake Mono, have I seen moraines in the form of *parallel ridges*, lying on a level plain and terminating abruptly *without any signs of transverse connection* (*terminal moraine*) *at the lower end*. Nor have I been able to find any description of similar moraines in other countries. They are not terminal moraines, for the glacial pathway is open below. They are not lateral moraines, for these are borne on the glacier itself, or else stranded on the steep cañon sides. Neither do I think moraines of this kind would be formed by a glacier emerging from a steep narrow cañon and running out on a level plain; for in such cases, as soon as the confinement of the bounding walls is removed, the ice stream spreads out into an *ice lake*. It does so as naturally and necessarily as does water under similar circumstances. The deposit would be nearly transverse to the direction of motion, and, therefore, more or less crescentic. There must be something peculiar in the conditions under which these parallel ridges were formed. I believe the conditions were as described below.

We have already given reason to think that the original margin of the lake in glacial times was three or four miles back from the present margin, along the series of rocky points against which the ridges abut; and that all the flat plain thence to the present margin is made land. If so, then it is evident that at that time the three glaciers described ran far out into the lake, until reaching deep water, they formed icebergs. Under these conditions, it is plain that the pressure on this, the subaqueous portion of the glacial bed, would be small, and become less and less until it becomes nothing at the point where the icebergs float away. The pressure on the bed being small, not enough to overcome the cohesion of the ice, there would be no spreading. *A glacier running down a steep narrow cañon and out into deep water, and forming icebergs at its point, would maintain its slender, tongue-like form, and drop its débris on each side, forming parallel ridges, and would not form a terminal moraine, because the materials not dropped previously would be carried off by icebergs.* In the subsequent retreat of such a glacier, imperfect terminal moraines might be formed higher up, where the water is not deep enough to form icebergs. It is probable, too, that since the melting of the great mer de glace and the formation of the lake, the level of the water has gone down considerably, by the deepening of the Truckee Cañon outlet by means of erosion. Thus, not only did the glaciers retreat from the lake, but also the lake from the glaciers.

As already stated, similar parallel moraine ridges are formed by the glaciers which ran down the steep eastern slope of the Sierras, and out on the level plains of Mono. By far the most remarkable are those formed by Bloody Cañon Glacier, and described in my former paper. These moraines are six or seven miles long, 300–400 feet high, and the parallel crests not more than a mile asunder. There, also, as at Lake Tahoe, we find them terminating abruptly in the plain without any sign of terminal moraine. But higher up there are small, imperfect, transverse moraines, made during the subsequent retreat, behind which water has collected, forming lakes and marshes. But observe: these moraines are also *in the vicinity of a great lake*; and we have abundant evidence, in very distinct terraces described by Whitney,* and observed by myself, that in glacial times the *water stood at least six hundred feet above the present level.* In fact, there can be no doubt that at that time the waters of Mono Lake (or a much greater body of water of which Mono is the remnant) washed against the bold rocky points from which the débris ridges start. *The glaciers in this vicinity, therefore, must have* run out into the water six or seven miles, and doubtless formed icebergs at their point, and, therefore, formed no terminal moraine there.

That the glaciers described about Lake Tahoe and Lake Mono ran out far into water and formed icebergs, I think is quite certain, and that parallel moraines opened below are characteristic signs of such conditions, I also think nearly certain.

f. Glacial Erosion.—My observation on glacial pathways in the high Sierra, and especially about Lake Tahoe, have greatly modified my views as to the

* Geological Survey of California, Vol. I, p. 451.

nature of glacial erosion. All writers on this subject seem to regard glacial erosion as mostly, if not wholly, a *grinding* and *scoring;* the débris of this erosion as rock-meal; the great boulders which are found in such immense quantities in the terminal deposit, as derived wholly from the crumbling cliffs above the glacial surface; the *rounded* boulders, which are often the most numerous, as derived in precisely the same way, only they have been engulfed by crevasses, or between the sides of the glacier and the bounding wall, and thus carried between the moving ice and its rocky bed, as between the upper and nether millstone. In a word, all boulders, whether angular, or rounded, are supposed to owe their *origin* or *separation* from their parent rock to atmospheric agency, and only their *transportation* and *shaping* to glacial agency.

Now, if such be the true view of glacial erosion, evidently its effect in mountain sculpture must be small indeed. Roches moutonneés are recognized by all as the most universal and characteristic sign of a glacial bed. Sometimes these beds are only imperfectly moutonneés, i. e., they are composed of *broken angular surface with only the points and edges planed off.* Now, moutonneés surfaces always, and especially angular surfaces with only points and edges beveled, show that the erosion by grinding has been only very superficial. They show that if the usual view of glacial erosion be correct, the great cañons, so far from being *formed,* were only very *slightly modified* by glacial agency. But I am quite satisfied from my own observations that this is not the only *nor the principal* mode of glacial erosion. I am convinced that a glacier, by its enormous pressure and resistless onward movement, is *constantly breaking off large blocks* from its bed and bounding walls. Its erosion is not only a grinding and scoring, but also a *crushing and breaking.* It makes by its erosion not only rock-meal, but also large *rock-chips.* Thus, a glacier is constantly breaking off blocks and making angular surfaces, and then grinding off the angles both of the fragments and the bed, and thus forming rounded boulders and moutonneés surfaces. Its erosion is a constant process of alternate *rough hewing* and *planing.* If the rock be full of fissures, and the glacier deep and heavy, the rough hewing so predominates that the plane has only time to touch the corners a little before the rock is again broken and new angles formed. This is the case high up on the *cañon walls,* at the head of Cascade Lake and Emerald Bay, but also in the *cañon beds wherever the slate is approached.* If, on the other hand, the rock is very hard and solid, and the glacier be not very deep and heavy, the planing will predominate over the rough hewing, and a smooth, gently billowy surface is the result. This is the case in the hard granite forming the beds of all the cañons high up, but especially high up the cañon of Fallen Leaf Lake, where the cañon spreads out, and extensive but comparatively thin snow-sheets have been at work. In some cases *on the cliffs,* subsequent disintegration of a glacier-polished surface may have given the appearance of angular surfaces with beveled corners; but, in other cases, in the *bed of the cañon,* and on elevated level places, where large loosened blocks could not be removed by water nor by gravity, I observed the same appearances, under conditions which forbid this explanation. Mr. Muir, also, in his Studies in the Sierra, gives many examples of undoubted rock-breaking by ancient glaciers.

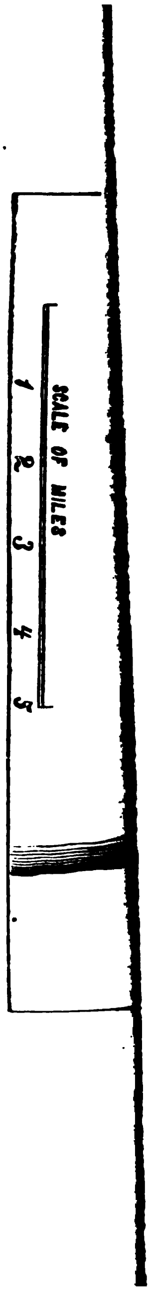
Angular blocks are, therefore, mostly the ruins of crumbling cliffs, borne on the surface of the glacier and deposited at its foot. Many *rounded* boulders also have a similar origin, having found their way to the bed of the glacier through crevasses, or along the sides of the glacier. But *most of the rounded boulders* in the terminal deposit of *great glaciers* are fragments *torn off by the glacier itself*. The proportion of angular to rounded boulders—of upper or air-formed to nether or glacier-formed fragments, depends on the depth and extent of the ice current In the case of the universal ice-sheet (ice-flood) there is, of course, no upper formed or angular blocks at all—there is nothing borne on the surface. The moraine, therefore, consists wholly of nether-formed and nether-borne severely triturated materials (*moraine profonde*). The boulders are, of course, all rounded. This is one extreme. In the case of the thin moving ice-fields—the *glacierets* still lingering amongst the highest peaks and shadiest hollows of the Sierra—on the other hand, the moraines are composed *wholly of angular blocks*. This is the character of the terminal moraine of Mt. Lyell glacier, described in my previous paper. These glacierets are too thin and feeble and torpid to break off fragments—they can only *bear* away what falls on them. This is the other extreme. But in the case of ordinary glaciers—*ice streams*—the boulders of the terminal deposit are mixed; the angular or upper-formed predominating in the small existing glaciers of temperate climates, but the rounded, or nether-formed, greatly predominating in the grand old glaciers of which we have been speaking. In the terminal deposits of these, especially in the materials pushed into the lake, it is somewhat difficult to find a boulder which has not been subjected to severe attrition.

Professor John LeConte described two new pieces of apparatus lately added to that of the University, one for projecting microscopic objects, and the other for measuring the force of electric currents.

Dr. Kellogg read a paper on Hops.

Resolutions expressive of interest in the affairs of the University, and satisfaction at the advancment made, were adopted.

President Gilman then addressed the members, after which the Academy adjourned to examine the buildings and grounds.


SCALE OF MILES
1 2 3 4 5

Regular Meeting, March 1st, 1875.

Robert E. C. Stearns in the Chair.

Eighteen members present.

The following names were submitted as candidates for membership: Alfred E. Regensberger, Jas. B. Clifford and Charles Frances.

Donations to the Museum: From Professor Davidson, specimen of Mandarin Duck from Nagasaki, Japan. From Mrs. John Torrence, specimens of *Ostrea titan* from San Luis Obispo Co. From Captain S. P. Griffin of the Steamship "City of Peking," specimens of eyeless eels (genus *Petromyzen* or *Bellostoma?*), caught coiled around fishing line in seven fathoms of water, mud bottom, in Fortesque Bay, Straits of Magellan, November 25, 1874; also intestinal worms found in the porpoise. Jas. Dean presented three Indian pestles made of stone, and nine bone bodkins or pins, from a large mound, covering two acres, and twenty-five feet deep, at Visitacion Valley, near San Bruno road; also specimens of coals from Queen Charlotte's Island; also coal from Vancouver's Island, and specimen of bog iron. E. O. McDevitt donated a large and choice assortment of New Zealand minerals. From Mrs. J. J Greene, fossil, *Tamiosona gigantea*, from Wild Horse Cañon, eight miles from Lowe's station.

The Secretary read a paper by S. B. Christy, as follows:

Notes on a Meteor seen at Berkeley.

BY S. B. CHRISTY.

On the evening of December 9, 1874, as I was sitting in my room, I happened to have my attention called to something without, and while looking from my window saw, what at first appeared to be the moon in her first quarter, of about the *same size*, *color* and *brilliancy*, shining through a dim fog, which latter was heavy enough to obscure all the lesser stars. As, however,

it flashed over me in a second that the moon was not out at that time and place, and as above all it was moving steadily downwards, and to the left, I watched it with attention and noticed that it seemed to grow a little larger and brighter, until finally, like a piece of burning paper, it seemed to flare up suddenly with a *reddish* light, and go out in silence.

The next day but one, as Professor John LeConte had asked me to record its appearance, as near as may be, I repaired to the same place at about the same time as before, so as to have the conditions as near the same as before, and with a transit took the bearings of its course as nearly as could be done by such a rude means of approximation.

Bearing at commencement	S. 83° E.
Bearing at end	S. 81° E.
Altitude at commencement	35°
Altitude at end	25°

The duration, as near as I could judge, was one second. The date, December 9, 1874; 6:30 P. M.

Charles Wolcott Brooks read the following:

Report of Japanese Vessels wrecked in the North Pacific Ocean, from the Earliest Records to the Present Time.

BY CHARLES WOLCOTT BROOKS.

Every junk found adrift or stranded on the coast of North America, or on the Hawaiian or adjacent islands, has on examination proved to be Japanese, and no single instance of any Chinese vessel has ever been reported, nor is any believed to have existed.

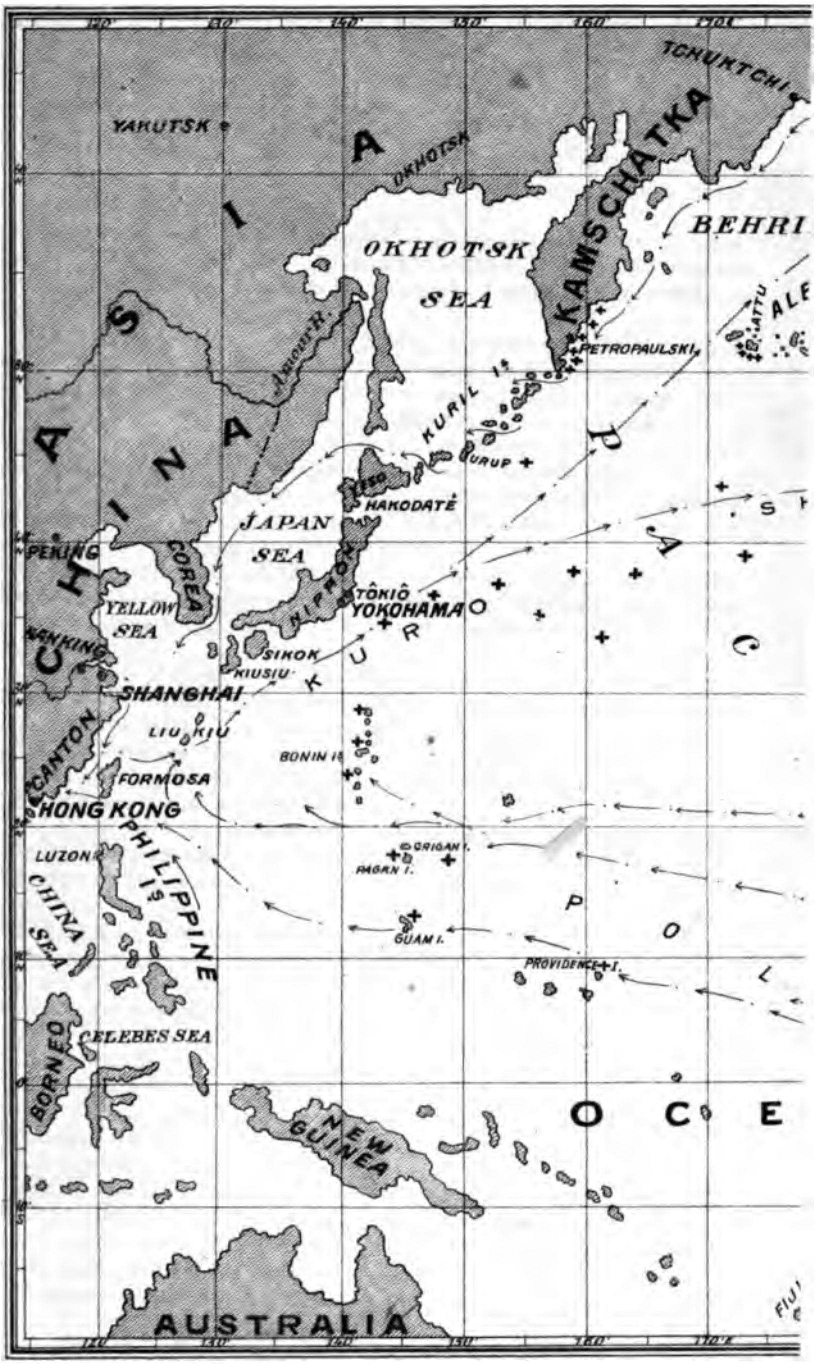
This may be explained by the existence of the Kuro Shiwo, literally "black stream," a gulf stream of warm water, which sweeps northeasterly past Japan toward the Kurile and Aleutian Islands, thence curving around and passing south along the coast of Alaska, Oregon and California. This stream, it is found, has swept these junks toward America at an average rate of fully ten miles a day.

There also exists an ocean stream of cold water, emerging from the Arctic Ocean, which sets south close in along the eastern coast of Asia. This fully accounts for the absence of Chinese junks on the Pacific, as vessels disabled off their coast would naturally drift southward.

A noticeable feature is the large number of disasters on the coast of Japan in the month of January, during which season the strong northeast monsoons blow the wrecks directly off shore into the Kuro Shiwo.

The climate of Japan is temperate, with the exception of the extreme northern provinces, where intense cold prevails and where snow is abundant; and the extreme southern provinces, whose climate is very warm.

About the year 1639 the Japanese Government ordered all junks to be built with open sterns, and large square rudders, unfit for ocean navigation, hoping



+JAPANESE WRECKS.

OUTLINE

Showing the Distribution of Disabled Ja

thereby to keep their people isolated within their own islands. Once forced from the coast by stress of weather, these rudders are soon washed away, when the vessels naturally fall off into the trough of the sea, and roll their masts out. The number, of which no record exists, which have thus suffered during the past nineteen centuries must be very large, probably many thousand vessels.

Among Japanese mariners, the fear of being thus blown off their coast, has been an ever-threatening danger; and the memory of such time-honored accidents, is a common feature in the traditions of every seaport settlement along the eastern coast of Japan.

By the Government Census, taken in 1874, the total population of Japan was 33,300,675 souls, and there were 22,670 registered sailing vessels of Japanese style, (junks) of from 8 to 383 tons, engaged in the coasting trade. The crews of ordinary trading junks average from eight to twelve men each.

In the sixteenth year of the reign of the Emperor Suizin, B. C. 81, merchant ships and ships of war are first spoken of as built in Japan.

Under the Shogoon Iyémitsu, about 1639, edicts commanded the destruction of all boats built upon any foreign model, and forbade the building of vessels of any size or shape superior to that of the present junk.

By the imperial decree of 1637, Japanese who had left their country and been abroad, were not allowed to return, death being the penalty for traveling abroad, studying foreign languages, introducing foreign customs, or believing in Christianity.

The Empire of Japan is situated in the northwestern part of the Pacific Ocean, and is composed of four large islands and of a great number of smaller ones. It faces to the northwest the Kingdom of Corea, and is separated from it by the Japan sea. To the northeast the archipelago of Chijima (Kurile Islands) extends towards Kamschatka. At the southwest the Liu Kiu Islands are situated opposite the Island of Formosa.

Its whole length, extending from one end to the other of the empire, measures more than 500 Ris (about 1225 English miles), and its breadth varies from 20 to 60 Ris (about 73½ to 146 English miles.) Its total area is 23,740 Square Ris.

The sources of information at command have been exceptionally good. During seventeen years, in which I represented the Government of Japan at this port, it has been my pleasure to devote much critical attention to the subject of Japanese wrecks, picked up adrift in the North Pacific Ocean and stranded upon the northwest coast of America and its various outlying islands, and those of the chain extending from Hawaii towards Niphon. Besides keeping a detailed record of all wrecks reported during this period, I have also collected and verified many cases of earlier reports, which although still extant, were likely to be overlooked.

In at least 37 of the cases quoted, I have either seen the saved, or received a personal account from those who were themselves witnesses. Hawaiian and Japanese traditions I have myself gathered in those countries.

In March, 1860, I took an Indian boy on board the Japanese steam corvette *Kanrin-maru*, where a comparison of Coast-Indian and pure Japanese words was made at my request, by Fukuzawa Ukitchy, then Admiral's Secretary;

the result of which I prepared for the press, and it was at that time published in the *Evening Bulletin*, suggesting further linguistic investigation.

The following examples submitted for consideration to the Academy, fairly illustrate the subject in its various phases:—

1. In Mr. Hubert H. Bancroft's unparalleled collection of ancient books and valuable manuscripts relating to the early history of the native races of the Pacific States, mention is made of several Japanese vessels reported in some of the Spanish-American ports on the Pacific. In 1617 a Japanese junk belonging to Magomé, was at Acapulco.

In 1613, June 10th, the British ship *Clove*, Capt. John Saris, arrived at Nagasaki, having on board one Japanese, picked up from the island of Bantam.

2. "In 1685," we read, "the Portuguese tried for the last time to re-establish their trade by sending back a number of shipwrecked Japanese, picked up adrift, to their own country. The Japanese did not molest them, but strictly prohibited their re-appearance on the Coast of Japan."

3. In 1694, a Japanese junk from Osaka was driven by adverse winds and weather and stranded on the coast of Kamschatka, at the mouth of the river Opala, on the south of Bolschaia Reka. The only survivor was afterwards taken to Moscow.

Muller, in his "Voyages from Asia to America," published in 1761, remarks that when in 1696 the Russians reported the above, they said: "we have learned of several other instances of Japanese wrecks previously stranded on the coast of Kamschatka."

4. In 1710, a Japanese junk was stranded on the coast of Kamschatka, in Kaligirian bay, north of Awatscha. Ten persons landed safely, of which four were killed and six taken captive in an encounter with Kamschadels. Subsequently four of the captives fell into Russian hands, and one named Sanima, was sent in 1714 to St. Petersburg.

5. On the 8th of July, 1729, a Japanese junk called the *Waka-shima* of Satsuma, in distress, after having been driven about at sea for six months, was finally stranded on the coast of Kamschatka, south of Awatscha bay, and 17 of her crew were saved. She was loaded with cotton and silk stuffs, rice and paper; the two latter articles shipped by *Matsudaira Osumi-no-kami*, (Prince of Satsuma) were government property.

A petty Russian officer named Schtinnikow, desiring to plunder the cargo, had fifteen of the survivors shot; for which crime he was subsequently condemned and hung. The two remaining, an old merchant named Sosa and a young pilot Gonsa, were sent to Irkutz in 1721, and thence via Tobolsk, they reached St. Petersburg in 1732, where one died in 1736, the other in 1739.

6. In 1782 a Japanese junk was wrecked upon the Aleutian Islands, from which the survivors were taken in one of the Russian-American Company's vessels to the town of Ochotsk, and thence to the inland city of Irkutsk. In 1792, the Governor-General of Siberia ordered the transport *Catherine*, then at Ochotsk, to return these men to their native country. The Russian vessel, after wintering in a harbor at the north end of Yeso, proceeded to the port of Hakodaté, where the Japanese officials politely but

firmly refused to allow their countrymen to land. They were subsequently returned to Siberia.

7. Among items of history mentioned in Japanese records, I find that in October, 1804, a Russian frigate commanded by Capt. Krusenstern, conveying Count Resanoff, as Ambassador of the Czar, brought back to Nagasaki five Japanese seamen, being part of a crew of fifteen rescued from a stranded junk; the other ten preferred to remain in Siberia.

8. In 1805, a Japanese junk was wrecked on the coast of Alaska, near Sitka; the seamen were quartered on Japonski Island, whence they were taken by the Russians, and finally landed on the Coast of Yeso in 1806.

9. In 1812, Capt. Ricord, commanding the Russian sloop-of-war *Diana*, took seven Japanese, six of whom were seamen recently shipwrecked in a junk on the coast of Kamschatka, in the hope of exchanging them for seven captive Russians, confined in Japan. Being unable to land, they were returned to Kamschatka, reaching there October 12th. The *Diana* made a second attempt, and finally succeeded August 16th, 1813, in landing these Japanese at Kunashie Bay, the 20th Kurile, and effected the liberty of the Russian Capt. Golownin and his associates.

10. In 1813, the Brig *Forrester*, Captain John Jennings, when in latitude 49° N., longitude 128° W., rescued the captain and two seaman from a dismasted junk, timber laden, when 18 months from Yeso, bound to Niphon. Thirty-five men were on board, of whom thirty-two died of hunger. They were delivered to the Russians, who undertook to return them to Japan.

11. Captain Alexander Adams, formerly pilot at Honolulu, relates that March 24, 1815, in latitude 32° 45′ N., longitude 126° 57′ W., when sailing master of brig *Forrester*, Captain Piggott, and cruising off Santa Barbara, California, he sighted at sunrise a Japanese junk drifting at the mercy of the winds and waves. Her rudder and masts were gone. Although blowing a gale, he boarded the junk, and found fourteen dead bodies in the hold, the captain, carpenter, and one seaman alone surviving; took them on board, where by careful nursing they were well in a few days. They were on a voyage from Osaka to Yedo, and were 17 months out, having been dismasted in consequence of losing their rudder.

12. In 1820, a junk was cast upon Point Adams, the southern shore of the mouth of Columbia river. The vessel, which was laden with wax, went to pieces, and the crew, many in number, landed safely.

13. A junk was wrecked on Queen Charlotte's Island, in 1831.

14. December 23, 1832, at mid-day, a junk in distress cast anchor near the harbor of Waialua, on the shores of Oahu. She was from a southern port of Japan, bound to Yedo with a cargo of fish; lost her rudder and was dismasted in a gale, since which she had drifted for eleven months. Five out of her crew of nine had died. December 30th, she started for Honolulu, but was stranded on a reef off Barber's Point on the evening of January 1, 1833.

The four survivors were taken to Honolulu, where, after remaining eighteen months, they were forwarded to Kamschatka, whence they hoped to work their way south through the northern islands of the group into their own country. This junk was about 80 tons burden. According to the tra-

ditions of the islands, several such junks had been wrecked upon Hawaii, before the islands were discovered by Captain Cook.

15, 16. In 1833, a Japanese junk was wrecked on the coast of Washington Territory, in the immediate vicinity of Cape Flattery. Many of her crew had perished, and several dead bodies were found headed up in firkins, in customary Japanese style, ready for burial. Out of 17 persons, the only survivors, two men and a boy, were rescued from the Indians, by the Hudson Bay Company's vessel *Lama*, Captain McNeal, who took them to England, touching at Honolulu on their way. Thence they proceeded to Canton, where they arrived in 1836, and stopped with Karl Gutzlaff, who learned their language, and intended accompanying them to Japan. In 1837, they left Macao in the American brig *Morrison*, dispatched by Clarence A. King for Yedo bay, to bear them home. Being fired upon, July 27, and prevented from landing, she sailed for Kagosima, where, being equally unsuccessful, she finally returned with the men to Macao. The *Morrison*, on whom Samuel W. Williams and Dr. Peter Parker were passengers, also had on board four other Japanese seamen, rescued from a disabled Japanese junk, which had drifted a long time at sea, until finally stranded on the eastern shore of the Philippine Islands, whence the survivors were forwarded to Macao, to be returned to Japan.

17. In 1839, a wrecked junk was boarded by Captain Cathcart of the American whale ship *James Loper*, drifting in latitude 30° N., longitude 174° W., or about half way between Japan and the Hawaiian Islands.

18. In the *Polynesian*, October 17, 1840, published at Honolulu, I find: "The Japanese who took passage in the *Harlequin* remained at Kamschatka under the protection of the Governor awaiting an opportunity of returning to their native country."

NOTE.—In 1834, the brig *Harlequin* conveyed to Petropaulski from Honolulu 18 Japanese taken from wrecks, who had remained 18 months at Honolulu. They were finally returned to Japan by Russian officials.

In 1840, Mr. Nathaniel Savory, a native of Massachusetts, residing at Port Lloyd, Bonin Islands, reports a Japanese junk of about 40 tons, laden with dried fish, entered that harbor in distress, having been driven from her course along the coast of Japan through stress of weather, with her provisions exhausted. They repaired the damage to the junk during that winter, and she sailed in the spring for Japan. Had these islands been uninhabited, this case would have added another to the list of wrecks.

19. In 1841, a fishing junk from the southeast part of Niphon was wrecked on an uninhabited island, where the three survivors remained six months, until taken off by Captain Whitfield, master of the American whale ship *John Howland*, and brought to Honolulu, where Denzo and Goémon remained, while Nakahama Manjiro went to the United States, and was educated by Captain Whitfield. After being there several years he returned to Honolulu where he found his former companions, and embarked January, 1851, on the *Sarah Boyd*, Captain Whitmore, bound for Shanghai, taking with them a whale-boat called the *Adventure*, with a full rig and outfit. When off the Grand Liu-Kiu, the three Japanese effected a landing and the ship proceeded without stopping. Hence they finally reached Kiushiu and Nagasaki, in the

junk which bears the annual tribute money from Liu-Kiu to Japan. Manjiro afterwards translated Bowditch's Navigator into Japanese, and visited San Francisco as sailing-master of the Japanese steam corvette *Kanrin-maru*, which arrived there March 17th, 1860.

20. In 1845, the United States Frigate *St. Louis* took from Mexico to Ningpo, in China, three shipwreck Japanese, being survivors of the crew of a junk which had drifted from the coast of Japan, entirely across the Pacific Ocean, and finally stranded on the coast of Mexico, where they remained two years. The Chinese authorities were willing to receive these men and return them to their native country by their annual junk, which sails from Cheefoo to Nagasaki; but the Japanese objected to their landing, owing to the law of 1637.

In 1845, the Japanese authorities informed Sir Edward Belcher, commanding H.B.S. *Samarang*, that they would not receive returned Japanese from abroad, but "had sent a junk-full back to the Emperor of China," to whose country they had gone to obtain return passages by the annual junk permitted from Cheefoo to Nagasaki. The above leads to the inference that the *Samarang* may have had shipwrecked Japanese seamen on board.

21. In 1845, April 1st, Captain Mercator Cooper, of Sag Harbor, when in the American whale ship *Manhattan*, rescued eleven shipwrecked Japanese mariners from St. Peters, a small island lying a few degrees southeast of Niphon, and took them to Yedo Bay, where they were received under exception. Captain Cooper is also reported to have fallen in with a sinking junk, from which he rescued as many more Japanese seamen. [See Dr. C. F. Winslow's account in *Friend* of February 2d, 1846.]

22. In 1847, a French whaleship while cruising off Stapleton Island, sighted a fire-signal on the shore, and sent a boat to the relief of five Japanese sailors, who were in a helpless plight; the only survivors of a crew, whose disabled junk lay stranded on the beach of a small bay. Later, about 1853, a party of officers from the U. S. steam frigate *Susquehanna* landed and surveyed this wreck, which they then described as "still partly kept together by large nails of copper, and portions of sheets of metal. Her planks, fastened together at the edge, were but little rubbed or decayed."

23. In 1847, April 21st, the Bremen ship *Otaheite*, Captain Weitung, when in lat. 35° N., long. 156° E., fell in with a Japanese junk in distress, which had lost her rudder and had been driven off the coast of Japan in a gale November, 1846, and had drifted five months. Took off the crew, consisting of nine men, also six tons of wax. She was about 80 tons burden and chiefly laden with paper belonging to Osaka, and bound north. Captain Weitung kept them on board four weeks, and May 19th, 1847, put them on board a junk in the Straits of Matsmai. [See *Polynesian*, October 17, 1847, and *Friend*, December 2, 1847.]

24. In 1848, Captain Cox of New London, Conn., picked up fifteen of twenty Japanese seamen from a disabled junk in lat. 40° N., long. 170° W., and kept them on board six mouths during a cruise in the Ochotsk sea, and finally landed them at Lahaina, where they remained six or eight months.

25. In 1850, during the autumn, S. Sentharo, Toro and J. Heco—the latter then aged 13 years—left Osaka in a junk for Yedo. After discharging and reloading they started to return via Woragawa. After leaving the latter

place their rudder was disabled and they lost their mast and drifted out to sea. Fifty days later the wreck was fallen in with by the American bark *Aukland*, Captain Jennings, who took off and brought the crew of 17 persons to San Francisco, in February, 1851. They were quartered on board the U. S. revenue cutter, and cared for by order of the Collector of the Port. Our citizens generally took much interest in them. The Japanese were subsequently embarked on the U. S. sloop *St. Mary's* and conveyed to Hongkong, where 15 were transferred to the U. S. steamer *Susquehanna* to await the arrival of Commodore Perry and his expedition. Heco and the second mate, Toro, returned to San Francisco on the bark *Sarah Hooper*, reaching there in the autumn of 1852. Sentharo returned with Rev. Mr. Goble, from San Francisco to Japan, and also Toro returned in the American bark *Melita* to Hakodaté from San Francisco, via Honolulu, April 19, 1859.

Toro was for a while clerk with Wells, Fargo & Co., and Joseph Heco, clerk with Macondray & Co. Heco was subsequently appointed for duty on the United States Surveying Schooner *Fennimore Cooper*, about 1858-59, and left her at Honolulu, on account of sickness, but finally returned to Yedo, on the United States steamer *Mississippi*. [See *Evening Bulletin*, June, 1862.]

26. In 1850, April 22d, in lat. 45° N. long. 155° E., the American whale ship *Henry Kneeland*, Clark, master, fell in with a Japanese junk having 13 persons on board. The vessel left Yedo for Kuno, but lost her rudder and was dismasted; then drifted to sea, and had been at the mercy of the winds and currents for sixty-six days, during forty of which they had subsisted on fish and snow water. The Captain and two seamen came to Honolulu on the *H. K.;* two of the crew were transferred to the *Marengo;* six were taken to Petropaulski and taken charge of by the Russian authorities, and two came to Honolulu by the *Nimrod*. [See *Friend*, October 15, 1850; also *Friend*, November 1, 1850.]

NOTE.—In 1851, by Japanese records I find that five Japanese seamen from Honolulu via China arrived at Nagasaki—probably the above.

27. In 1851, a Japanese junk was cast away upon Atka Island, and only three of the crew survived.

28. In 1852, April 15th, in lat. 31° N., long. 150° E., about 300 miles N. N. E. of Guam, Captain West, in the American whaleship *Isaac Howland*, fell in with a small Japanese junk in ballast. The four men on board had but a little oil to sustain life, and were much emaciated. Their tiller was lashed, and the vessel having been forty-nine days out of their reckoning, the crew had given themselves up to die. Two of these men Captain West took to the Atlantic States, and two were transferred to an American whaler about to cruise in the vicinity of the Japanese Islands.

29. In March, 1853, the American ship *John Gilpin*, Captain Doane, passed a water-logged wreck of a junk, her deck awash with the water, in lat. 18° —' N., long. 145° —' E., just beyond Pagan and Grigan Islands. Large numbers of fish were around the wreck. There were no survivors on board. She had every appearance of having been a very long time in the water.

30. In 1853, Captain C. M. Scammon discovered the wreck of a Japanese junk, on the southwest or largest of the San Bonito group of Islands, off

Lower California, in lat. 28° N., long. 116° W., and near Cedros Island. [See *Alta*, April 22, 1860.]

Her planks were fastened together on the edges with spikes or bolts of a flat shape, with all of the head on one side. The seams were not quite straight, although the workmanship otherwise was good. That portion of the wreck in sight, was principally the bottom of the vessel, and gave evidence of having been a long time on shore. [Extract from Captain Scammon's log.]

31. In 1854, August 14th, just after Commodore Perry's departure, the American ship *Lady Pierce*, Captain Burrows, arrived at Simoda from San Francisco via Honolulu June 2, 1854. She returned Diyonoské to Japan, who was the sole survivor of a crew of fifteen men, and was picked off from a drifting junk near the Hawaiian Islands, after being seven months helpless at sea. He had resided some time in San Francisco.

32. In 1855, Captain Brooks, in American brig *Leverett*, which arrived here from Ayan, Siberia, November 29th, picked up an abandoned junk in lat. 42° N., long. 170° W., about 900 miles from the American Coast.

33. In 1856, the American bark *Messenger Bird*, Captain Homer, reported a disabled junk at Guam, Ladrone Islands.

34. In 1856, Captain Jno. C. Lawton, in the brig *Prince de Joinville*, while getting guano at Cedros and adjacent islands, reported a Japanese wreck, seen near Magdalena Bay.

35. In 1858, the U.S. surveying schooner *Fennimore Cooper*, Lieut. John M. Brooke, U.S.N. commanding, sailed from Honolulu for a cruise along the chain of islands extending thence towards Japan. He had on board a Japanese seaman named Marsa-Kitchi, whom he landed at Kanagawa. The junk from which this man was taken, was disabled at sea while engaged in the coasting trade, and her crew were forced to put her before the wind, heading to the eastward, a direction in which they were forced against their will. To prevent drifting too rapidly, they lowered their anchor in the open sea to act as a drag, paying out their full length of cable, and thus allowed it to remain until it finally parted.

36. In 1858, May 19th, the British ship *Caribean*, when in lat. 43° 40′ N., long. 171° E., about 1,600 miles from the coast of Japan, fell in with a dismasted junk, which had carried away her rudder, and had been about five months floating helplessly at sea. The captain, mate and ten seamen were rescued and brought to San Francisco, where they arrived June 7, 1858. They were cared for by Captain Winchester, who took them in the *Caribean* to Vancouver Island, whence he was bound for China, but having met a British war vessel off Japan, the rescued men were transferred to her, and thus landed at a Japanese port.

The junk was loaded with barley and rice, and barnacles two feet long were reported found upon the wreck.

The British Government presented £400 to Captain Winchester as a reward and in reimbursement of his necessary outlays.

37. In 1859, the bark *Gambia*, Captain Brooks, found the remains of a Japanese junk on Ocean Island, lat. 28° 24′ N., long. 178° 21′ W.

38, 39. In 1859, July 4th, the remains of two stranded junks, with lower

masts high on the beach, were found on the east or lagoon side of Brooks Island, lat. 28° 11′ N. long. 177° 18′ to 25′ W.,

40. May 11th, 1862, the bark *Yankee*, Captain Claxton, passed in lat. 25° 39′ N., long. 138° 24′ W., a wreck with the stump of one mast only standing, of which the wood was quite black with age. The junk was water-logged, and the sea washing entirely over her. Being satisfied there was no life upon her, and a heavy sea running, did not board; passed her three-quarters of a mile to windward, and the *Yankee* kept on her course.

41. In 1862, a Japanese junk was stranded in September near Attu. They had drifted in distress for 90 days, and out of a crew of twelve only three survived. These were taken in 1863 to Nicolaefsky, Amoor river, and then returned to Hakodaté by a Russian war vessel.

42. In 1862, May 4th, the ship *Victor*, Captain Crowell, arrived at San Francisco, with the captain, officers and crew, eleven in number, of the Japanese junk *Io-maru*, from Kanagawa, December 21, 1861, for Owari and Hiogo. On January 5, 1862, was disabled and drifted from land. Was about three months at the mercy of winds and currents, until picked up April 13th, 1862, in lat. 33° N., long. 161° 26′ E., by the *Victor*. They were cared for by Mr. Brooks, Japanese Consul, and by him returned to Japan, in the American schooner *Caroline E. Foote*, for Hakodaté.

43. A Japanese junk drifted past Baker's Island, lat. 0° 13′ N., long. 176° 22′ W., some time in 1863. Boats were sent out and towed it on to the beach. There were four Japanese bodies on board; all were dead.

44. In 1864, February 4th, on Providence Island, lat. 9° 52′ N., long. 160° 65′ E., on the Lagoon shore of the island was seen the portions of a vessel which had been many years a wreck. Scattered along the outer shore were many redwood logs, some of them of great size.

45. In April, 1869, an abandoned junk was stranded on Adakh, one of the Aleutian Isles.

46. In 1870, in October, the San Salvador ship *Louisa Canovera*, Captain Demoro, when in lat. 37° 46′ N., and long. 158° 10′ E., fell in with a dismasted junk, laden with rice, having four dead bodies on board, and no living persons. The papers and effects were taken and delivered to the Japanese Consul at San Francsico, and by him returned to Japan, November, 1870.

47, 48, 49. In July, 1871, the old chief at Attu Island, aged 70 years, reported that three Japanese junks had been lost upon the surrounding islets, during his recollection, besides one stranded not far from the harbor of that island in 1862.

50. In 1871, February 2d, in lat. 33° 45′ N., long. 141° 31′ E., about 150 miles from the coast of Japan, the American ship *Annie M. Smull*, Captain Packer, fell in with the Japanese junk *Sumi-yoshi-maru*, of Kiushiu, and rescued the Captain and three surviving seamen, and landed them at San Francisco, February 24, 1871. They sailed from Shiroko, province of Ise, January 17, 1871, for Dai Osaki, with a cargo of wood. Two days later they were disabled, and drifted to sea, and were picked up seventeen days later.

51. In 1871, May 23d, in lat. 34° 54′ N., long. 143° 32′ E., Pacific Mail steamship *China*, Captain Cobb, rescued five Japanese seamen from the disabled junk *Sumi-ayee-maru*, of Kobe. Eleven out of sixteen originally on

board died upon the wreck, and the captain of the junk died on the steamer after being rescued. They were cared for by Mr. Brooks, who returned them to Yokohama, July 1, 1871, and the government presented suitable rewards.

52. In 1871, the Japanese junk *Jinko-maru*, of Matsaka, of 180 kokus measurement, encountered a severe gale January 18, 1871, while going from Isé to Kumano, during which she lost her rudder, and while in danger of foundering cut away her masts. The junk drifted from the coast of Japan in the Kuro Shiwo for 2,500 miles in a helpless condition, her crew keeping a fire and living on rice, and fish they speared, until they drifted on the rocks at Atka, July 10th, 1871, where, by means of ropes, the three men on board landed safely. There they remained until September 19th, 1871, when they took passage by schooner *H. M. Hutchinson* for Ounalaska and San Francisco, whence they were returned to Japan by the Consul.

53. In 1873, Captain W. B. Cobb, in steamer *China*, rescued the crew from a wrecked junk in lat. —° —′ N., long. —° —′ E., and landed them at Yokohama, in acknowledgment for which the usual present was made him by the Japanese government.

54. A junk has been reported as stranded on the coast of Alaska.

55. A junk was cast upon the windward side of Kauaii, one of the Hawaiian Islands, and the survivors landed at Hanalei harbor.

56. An old resident of Petropaulski informed me there was a Japanese junk stranded below that harbor, previous to 1812, where many years since the wreck still remained. Six of the crew survived.

57. A Japanese wreck was sighted adrift below San Diego. Reported in the *Alta*.

58. A junk was wrecked at Nootka Sound.

59. In 1875, April 6th, in lat. 38° 02′ N., long. 164° 38′ E., American ship *Game Cock*, Capt. T. C. Stoddard, fell in with the Japanese junk *Woonohi-maru*, of about 80 tons, dismasted, with her stern stove and rudder gone, and generally in a helpless condition, and rescued therefrom twelve Japanese seamen. The junk was bound from Hakodaté to Tokio, with a cargo of salt fish and sea-weed, when on December 3d they were blown off shore in a severe gale. December 10th they again made the land, when another heavy gale commenced and blew the junk off again. December 19th was forced to cut away the mast to save the hull. December 22d raised a jury mast and got under way, sailing towards Japan whenever the wind permitted; at other times took in sail and drifted. By their reckoning, they estimate having thus sailed 1500 miles west, principally with northeast winds, when, April 5th, in a bad sea, they carried away rudder, and soon after stove stern. At 8 A.M. the following day, they abandoned the wreck, from which they were rescued by the *Game Cock*, and landed at San Francisco April 28th, and were returned to Japan by Mr. Takaki May 1st, per *Great Republic*. For the rescue and kind treatment of these men, the Japanese Government presented Capt. Stoddard with a gold chronometer watch through His Excellency Yoshida Kiyonari, their Minister at Washington.

60. In 1876, July 3d, in lat. 37° 10′ N., long. 167° 35′ E., British barque *Abby Cowper*, Capt. Nelson, fell in with the Japanese junk *Koki-maru*, of Otaru, island of Yeso, of 477 kokus government measurement, equivalent to

about 120 tons. The junk was dismasted and floating in a helpless condition. Sakaki-bara Katsubé, mate, and Tomokitchi, sailor, the only survivors of 12 men, were rescued from the wreck, and made the following statement, which is very interesting as an illustration of many doubtless similar struggles. In October, 1875, the junk loaded at Shari and Abashiri, on the northern coast of the island of Yeso, with salted salmon and preserved roe of salmon. Left latter place November 5th, and touched at Hakodaté, whence they sailed December 6th for Tokio, Niphon. On the 9th, when on the east coast of Japan between lat. 39° and 40° N., and about long. 142° E., a severe westerly gale was encountered. December 12th carried away mainmast. Afterwards got it in and fished it with a piece of the main yard. On the 18th carried that mast away, and the yard was washed overboard. A sea soon after disabled the rudder, which was unshipped and taken in, the vessel in the meantime making water freely. To lighten her, 300 kokus of cargo (nearly two-thirds), was thrown overboard. From this time the vessel floated helplessly.

Early in January, 1876, fresh water gave out, and all the rainwater possible was saved and used. Then three seamen were taken down with the scurvy, which soon appeared among the balance. Towards the close of January, firewood gave out, but a small nucleus of fire was preserved in a stove. As a last resort, the junk's boat was broken up for firewood. All hands subsisting on a little rice cooked in rain water, and principally on salt fish, with a very small allowance of water. February 5th Chojero died—the first death. March 9th, Capt. Sato Sangoro died; then followed Kitsaburo, April 16th; Bunkichi, 21st; Kizo, 24th; Renkitchi, May 2d; Skedjero, 2d; Taské, 2d; Heihichi, 14th, and finally, Matsutaro, June 10th. The two survivors, anticipating a similar death, lingered until the forenoon of July 3d, when they sighted a vessel, had strength enough to raise a signal, and were rescued. They caught rain May 24th, after nearly all had died, which largely assisted in preserving the survivors. They also caught fifteen large fresh fish called *bonita*. Before the captain died, he wrote and handed to the mate letters to his family and owners, describing all details. The two survivors, expecting death themselves, boxed these up, with the ship's papers, and fastened them in a conspicuous place, whence they were taken and preserved. After the death of each person, the survivors enclosed their bodies in a Japanese coffin suitably inscribed, and stowed them in the hold of the junk, hoping they might reach some land and receive burial. The survivors reached San Francisco August 15th, 1876, and after recuperating, were returned to Japan by Mr. Takaki.*

Many more might easily be added, but these suffice to establish many facts valuable to science.

The annual rainfall of Japan averages 70.33 inches, occurring on 197.7 days, two-thirds of which falls between April and October; at Tokio the thermometer varies from a monthly maximum of 91° Faht. in August, to a minimum of 20° in January, averaging 58° 22 for the year, and averages 48° 33 at Hakodaté, where the average number of hard gales per annum is 16.79. [See Kaitakushi Reports and Tables. Tokio, 1875.]

*—NOTE.—These last two cases have been submitted by Mr. Brooks as additions to the list for publication since the reading of this paper.

The presence of wrecks so far south near the equator, indicates that they had been swept northward from Japan by the Kuro Shiwo, and thence southward along the northwest coast of America until they fell into the equatorial westerly current, where, in company with redwood logs, and drift-wood from Oregon, they must have reached these islands in the equatorial belt.

In illustration of this equatorial current, we have the report of residents of Christmas Island, which speaks of a westerly current setting past that island at the rate of one and a-half to two miles an hour. August 23d, 1861, there was picked up on the shore of the island of Niihau, in latitude 21° 50′ N., longitude 160° 15′ W., a bottle containing a paper, thrown from the American ship *White Swallow*, thrown overboard July 21st, 1861, in latitude 21° 30′ N., longitude 151° 55′ W. It had made a nearly due west drift of 460 miles in about thirty-three days. This shows the existence of a very powerful westerly current around the Hawaiian Islands of about 14 miles per diem.

In 1862, September 10th, an enormous Oregon tree about 150 feet in length and fully six feet in diameter above the butt, drifted past the island of Mauii, Hawaiian Islands. The roots, which rose ten feet out of water, would span about 25 feet. Two branches rose perpendicularly 20 to 25 feet. Several tons of clayish earth were embedded among its roots. Many saw-logs and pieces of drift-wood came ashore in this vicinity about this time. These were evidently portions of the immense body of ship-timber launched upon the Pacific during the great flood of the previous winter along the American coast. Their almost simultaneous arrival at Mauii in September, seems to indicate quite accurately the force and direction of the currents in this ocean. Supposing them to have come from the Columbia River, leaving say February 18th, 1862, and to have drifted 2,800 miles, they must have drifted at an average rate of 14 miles per day to have reached Mauii September 10th.

We may argue from the above that there were other ways of explaining the similarity of flora upon many islands of the Pacific and the high terraces of our Sierra Nevada mountains, beside the hypothesis of an intervening continent where the broad Pacific now rests.

There is a strong presumption that the present bed of the Pacific Ocean may once have been an extended valley, submerged by some abrupt and spasmodic catastrophe, at a period when the fiery interior of the earth was in a state of inconceivable agitation, and its equilibrium temporarily disturbed. Abundant ruptures of the entire combined strata of its crust along our mountain ranges, bear indisputable evidence, in prominences tilted up and raised to immense heights: conditions which must have necessitated corresponding depressions, and consequently established new beds for water, forming new islands, re-dividing and re-shaping continents. The existing shore lines of enormous empty basins, the pebble and cobble stones rounded by erotion, at present in the centre of this continent west of the Rocky Mountains, all contribute testimony of some great change.

The spores or seeds of plants may, however, have been more recently transferred by clinging to the earth around the roots of such mammoth trees as floated from the high latitudes of the northwest coast of America. Once cast upon any island and rooted, they would soon replant and extend themselves. Driftwood from Columbia River and Puget Sound distributed itself

throughout the North Pacific, and the windward shores of the Hawaiian Islands are literally lined with it, as well as with redwood logs of formidable size.

Small parties of male Japanese have repeatedly reached the American continent by sea, cast upon its shores after floating helplessly for months. Until recently, the survivors must have remained permanently near where they landed, and naturally uniting with women of the native races, have left descendents more or less impressed with their physical peculiarities. Such a slow, limited, but constant infusion of Japanese blood, almost entirely from male seamen, was undoubtedly sufficient to modify the original stock of all coast tribes along our north-western shore. No marks exist of any immigration *en masse*, neither is there any present record of any Japanese woman saved from such a wreck, although cases may formerly have occurred, but must have been very rare. These unfortunate seamen, often illiterate, and separated from their sources of learning, necessarily lost their own language; but in doing so, doubtless contributed many isolated words to the Indian dialects of this coast. Many shipwrecked Japanese have informed me that they were enabled to communicate with and understand the natives of Atka and Adakh Islands. Quite an infusion of Japanese words is found among some of the coast tribes of Oregon and California, either pure, as *tsche-tsche*, milk, or clipped, as *hiaku*, speed, found reduced to *hyack*, meaning fast, in Indian; or *yaku*, evil genius in Japanese, similarly reduced to *yak*, devil, by the Indians. In almost all words showing such similarity, the Indian word is always an abbreviated word, or shorter word than the Japanese, from which it may be argued that the latter was the original and the former derived. The construction of the two languages is, however, different. There are, however, a large number of pure Japanese words and some very peculiar Japanese "idioms, constructions, honorific, separative, and agglutinative particles" found nearly identical in the American-Indian dialect. Shipwrecked Japanese are invariably enabled to communicate understandingly with the coast Indians, although speaking quite a different language. The great mass of the Japanese people stoutly disclaim any common descent with the Chinese, and firmly believe they have a wholly different origin. Any common ancestor must certainly have been in very remote ages.

Professor George Davidson, in charge of the United States Coast Survey on the Pacific, our highest authority upon questions connected with the great ocean currents of this ocean, has bestowed much critical study upon the physical conditions connected with the Kuro Shiwo. In 1851, when stationed at the mouth of the Columbia river, he began the interesting investigations necessary to demonstrate its complete outline.

In 1868, he communicated to the National Academy of Science his deductions establishing the existence of the return current northwestward, westward and southwestward along the shores of the Gulf of Alaska, and the southern coast of the Aleutian Islands, whilst the great body of the current is deflected down the northward coast until it is drawn into the Great Equatorial Current which moves westward until it strikes the Asiatic barrier, and thence starts on its course, about the island of Formosa, as the great warm stream of Japan. He first showed the striking analogy between this stream and that of the

North Atlantic, especially in their origin at latitude 23°, their being nearly 180 degrees of longitude apart, their general course, etc., etc.

There is a branch of the Kuro Shiwo, which shoots off northward near Kamschatka, and is felt 50 or 100 miles off this promontory; whilst close in shore, a cold current flows southward from the Arctic through the western part of Behring's Straits. On Kamschatka, the Kurile and Aleutian Islands, and on Alaska, great number of disabled Japanese junks must have been stranded in past centuries.

Professor Davidson, who has had occasion to examine the Spanish, English, Russian and American records of discoveries in this ocean, assures me that he has found mention of at least a dozen or more junks, wrecked on the coasts of Kamschatka, within a comparatively recent period; and in the earlier descriptions of the Kurile Islands, and of the Kamschatka Peninsula, he says frequent mention is made of the wrecks of Japanese junks upon these coasts.

Both winds and currents of the North Pacific assist in driving disabled Japanese junks around the great circle of the Kuro Shiwo. A junk disabled in the latitude of Tokio would be swept by alternate southwest and northwest winds, and the existing northeasterly current, towards the northwest coast of America. The distance from Cape King to San Francisco is about 4,500 nautical miles. We have here abundant proof of the track taken by these disabled vessels, by a study of their positions when found drifting at sea in the Pacific, at the mercy of winds and waves.

For many, many centuries the coasting trade of Japan has employed a large fleet of junks in exchanging rice from their southern, for salt fish from their northern ports. Although it may be presumed that the large number of their vessels thus disabled and rendered unmanageable, undoubtedly founder in the heavy gales they experience; yet comparatively large numbers having cargoes suitable for food, and crossing a region subject to much rain, which is easily caught, are enabled to sustain life until either picked up, or stranded somewhere on the American coast, or some island in their course.

In the above sixty cases enumerated, there were, from 1613 to 1694, four cases; from 1710 to 1782, three cases; 1804 to 1820, six cases; 1831 to 1848, eleven cases; and since the rapid settlement of this coast in 1850 to 1876, only 28 years, we have a list of 36 wrecks reported. This apparent increase is not owing to their increased number, but solely to the fact, that increase of commerce on the Pacific has distributed there a large fleet, whose presence has materially increased the chances of rescue to disabled vessels, and the likelihood of receiving reports from stranded wrecks.

In addition to the list we have enumerated, are the Hawaiian traditions that *several* such junks were wrecked on Hawaii before the year 1778; to which add the wrecks from which the 18 Japanese were returned from Honolulu in 1834, also those from which came the junk full of shipwreck Japanese, who attempted to, and failed in returning, by Cheefoo to Nagasaki; also the dozen additional ones, alluded to by Professor Davidson, as stranded on the peninsula of Kamschatka, within a comparatively recent period; and the frequent mention of similar wrecks on the Kurile Islands. These all taken together, with yet others not fully verified, could scarcely have been less than forty

more, rendering it reasonable to suppose that fully one hundred wrecked Japanese junks, have been heard from, in one way or another, adrift upon the North Pacific, or stranded on the northwest coast of America or some outlying islands.

In answer to the question of whether any of these waifs have ever found their way back to Japan from the American coast. in early times, I can say, that from historical data still extant, and from the personal relations of descendants of some of such returned voyagers, I have learned that in rare cases, occurring from 400 to 260 years ago, crews actually reached Japan with tidings of the American coast; and Professor Davidson informs me, that when recently in Japan observing the Transit of Venus, a very intelligent Japanese scholar, well known to me personally, related to him a well authenticated case within this century. Formerly such accounts were not allowed general publicity, because stoutly discountenanced by an ecclesiastical government, to whom such discoveries were quite as repugnant as were Galileo's to the medieval government of Rome. To the peaceful masses, the confines of their archipelago, were but recently the horizon of the world.

The famous voyage of the Buddhist priest from China, at the beginning of the seventh century, to a country called by him Fusang, (meaning, translated "to aid or cultivating mulberries,") was at the exact period when Japanese historians record their first official intercourse with China; and was probably reached by a coasting voyage along the western coast of Corea, thence along the northern coast of Niphon, around Yeso, and southerly, to the southeastern shore of Niphon, where mulberry trees were then cultivated abundantly, and which was undoubtedly the land he called Fusang. A careful study of the native records seems to indicate that his much mooted Chinese voyage could not possibly have extended to the American coast.

Of the sixty cases here reported, 27 wrecks were encountered at sea, and the balance stranded, as follows: On the Aleutian Islands, 8; Coast of Kamschatka, 6; Alaska, Oregon, Hawaiian and Brooks Islands, two each; Off San Diego. Acapulco, Nootka Sound, San Bonito, Queen Charlotte, Cedros, Providence, Baker's, Stapleton, Ocean and Ladrone Islands, one each.

In 23 cases where the actual number on board was named, they aggregated 293 persons; an average of 12¾ persons to a junk; ranging from 3 to 35 in individual cases.

Where definite statistics of the saved are given. we find 222 persons saved in 33 cases; an average of 6¾ persons in each disaster. On eight occasions, three persons each were rescued; in four cases, one person; and on four other cases, four persons; three times, eleven were saved; and twice each, 5, 12, 15, 17; and once each 2, 6, 7, 9, 10, 13, were saved.

By an examination of the above figures, we may estimate the probable extent of Japanese blood infused into the Indian tribes around the shores of the North Pacific.

Fifteen vessels mention having drifted helplessly at sea an aggregate of 106½ months, averaging a little over seven months each.

Eleven cases report 122 deaths; averaging a little over eleven deaths to each wreck.

It is sincerely hoped that the publication of this record, which has so interesting an ethnological import, may result in awakening Japan to the adoption of immediate steps in the great interest of a common humanity; for by improving the models of her vessels, and adopting those with sea-going qualities, this long record of disasters may speedily be abridged, if not wholly terminated.

About a year since it became my duty to forward to Japan, half a dozen wooden models, full drawings and specifications of small vessels, varying from 40 to 200 tons, ordered by the Japanese government for the use of shipbuilders, which the now enlightened government has recommended, them to adopt, instead of their present form of junks. Thus the edict of 1639 has passed away forever, and young Japan is rising to take her equal place among the advancing nations of the world.

Few are better aware than the scientist, of the manifold and inevitable dangers which attend all radical changes, when suddenly made; for success is a problem seldom solved without repeated trials and inevitable failures. But to-day, Japan is earnestly seeking to establish her national perpetuity, by fostering a discriminating intelligence among her people, and by encouraging general and liberal education among the masses. Thus she reverses in the most practical manner, the other edict alluded to as promulgated in 1637. Her centuries of quiet seclusion are now embalmed with the history of the past, and she seeks true greatness in an enlightened administration of her national affairs, and bids fair henceforth to reciprocate a generous friendship towards all members of the great brotherhood of nations, from whom she may now claim equal sympathy and neighborly protection.

The great changes in Japan can not be better illustrated than in the fact, that it is now customary for the government of Japan, in common with all other nations, to present through their Foreign office, some suitable reward in acknowledgement of kind service, to the captains of vessels who rescue their shipwrecked seamen.

The Japanese Government have now in their navy ten war ships, five dispatch vessels, and five training ships, all steamers; and in their mercantile marine, one hundred and two steamers of various tonnage, aggregating 30,718 tons; also 32 modern sailing vessels built in foreign style of 7,346 total tonnage.

The great Pacific Ocean and its adjoining waters, under the impulse of this age of steam, is becoming the highway of an enterprising commerce, and steadily unfolds an attractive field of research to ethnological and linguistic archæologists.

Many young Japanese are already attracted to scientific pursuits, and their valuable technical as well as general results, are beginning to claim the attention of naturalists.

Much valuable scientific work has been done by Japanese scholars since their early lessons received from Professor Wm. P. Blake and Professor Raphael Pumpelly; two eminent American scientists, whom I had the honor

of selecting and engaging in the summer of 1861, on behalf of the government of Japan, to act as government Mineralogists and Mining Engineers.

A glorious opening now presents itself for some reliable and competent scholar, with pecuniary means at command, to collect a library of books relating to the Asiatic shores of the North Pacific ocean, as perfect in its way as is that of our great historian, Hubert H. Bancroft, relating to the native races of the American coast; and when as systematically classified, and as thoroughly studied, give to the world full and correct historical details and analytical classifications of all native races on the borders of Asia; many of whose records and traditions must necessarily fade with radical changes in civilization, and soon pass beyond human reach.

The splendid sunrise, now dawning in the Orient, offers golden opportunities, which should be promptly improved while available. Old ways are giving place to new, and invaluable treasures of antiquity may be lost forever, or cast aside to linger for a generation or two, in the memories of the aged, before their shadowy forms become enshrouded in the misty veil of a forgotten past.

Dr. Stout referred briefly to the death of Sir Charles Lyell, and a Committee of three was appointed to draft appropriate resolutions. The Chair appointed John Muir, H. G. Hanks, and Dr. A. Kellogg.

Regular Meeting, March 15, 1875.

Vice-President Gibbons in the Chair.

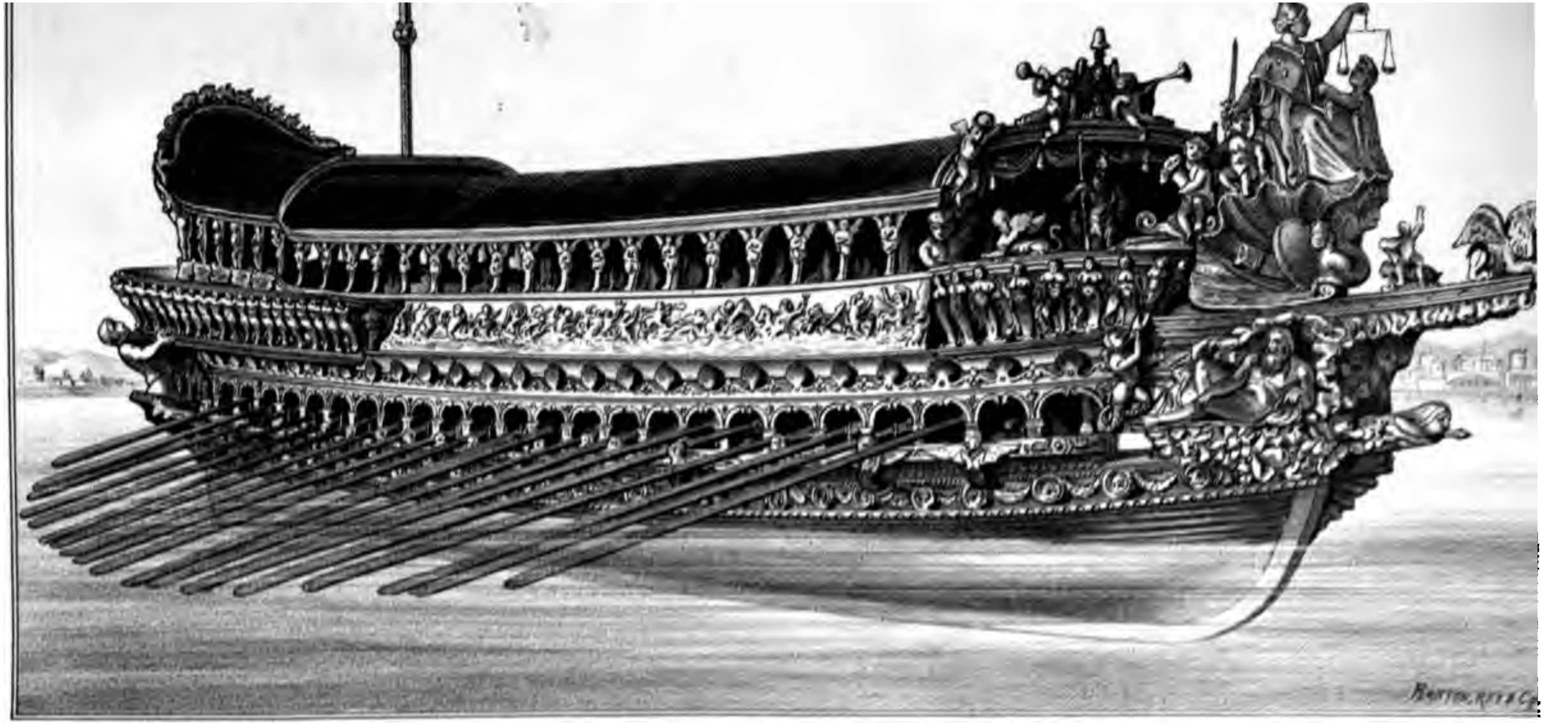
Twenty-two members present.

Henry R. Taylor and J. W. Anderson were elected resident members; and Arthur C. Taylor was proposed.

Donations to the Museum: From John Muir, lava from Mt. Shasta; also specimens of *Pellea ternifolia* and *Cupressus McNabiana*.

Mr. Amos Bowman read a paper on Terraces in the Coast Range as related to the detritus of glaciers and of the ancient rivers.

Charles Wolcott Brooks read the following paper:



THE BUCENTORO, A STATE GALLEY OF VENICE.

Early Migrations—Ancient Maritime Intercourse of Western Nations before the Christian Era, Ethnologically considered and Chronologically arranged, Illustrating Facilities for Migration among early types of the human race.

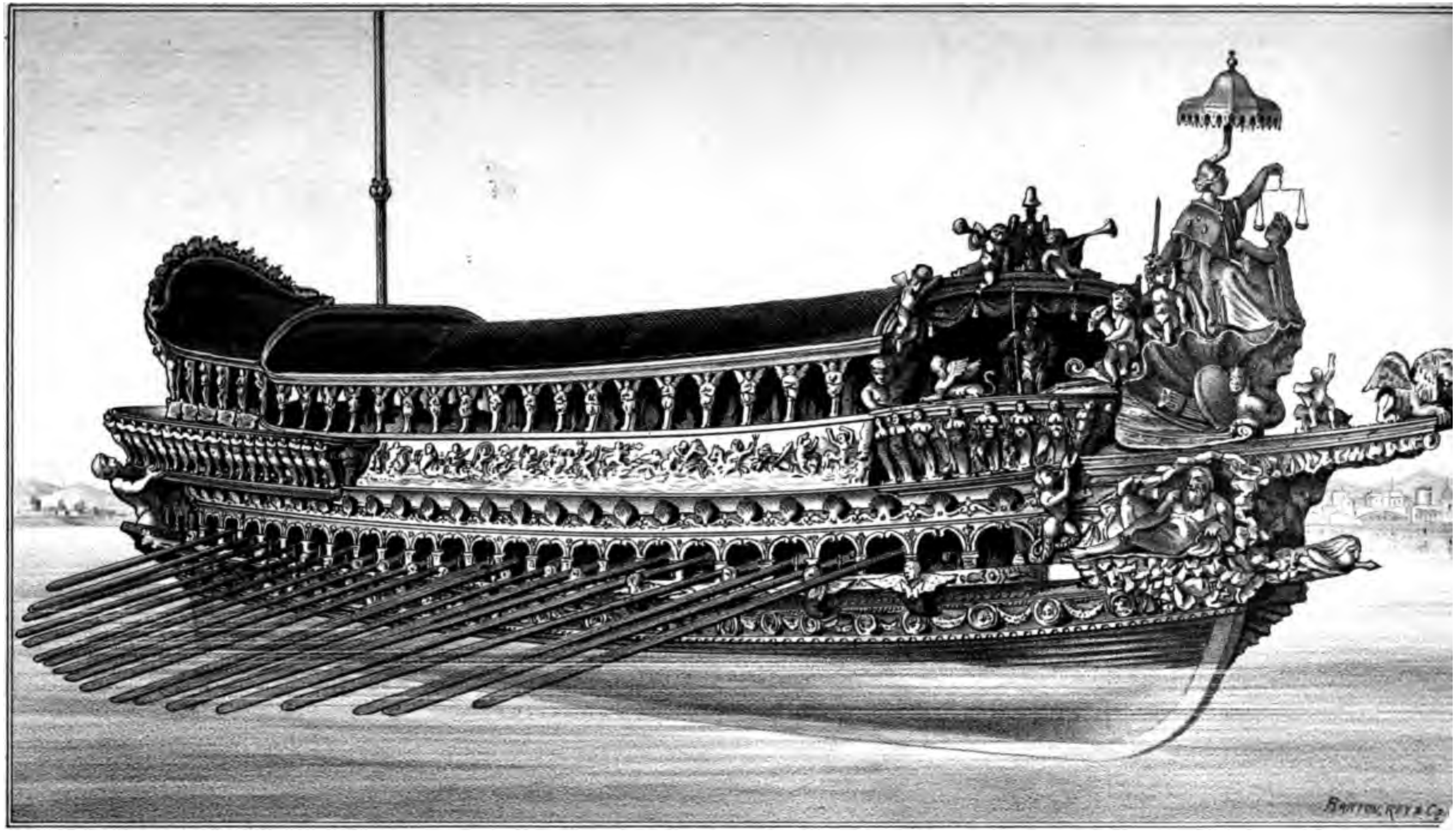
BY CHARLES WOLCOTT BROOKS.

In all subdivisions of races, we are apt, at first, to look superficially upon different nations as separate and complete types of humanity. The brief synopsis here collected from ancient histories, clearly reveals the extent of maritime intercourse, actually developed by western nations up to fully 4,000 years ago. By such statistics, acquired with sufficient details to trace facilities for admixture, the inference fairly follows: that maritime nations of Asia, including the Japanese, whose origin we are soon to examine, may have enjoyed like facilities of intercommunication; and consequently, in common with all maritime peoples at this stage of human existence, became to a certain extent mixed and composite.

Until we reflect, we know not the possibilities of human nature. The exact justice of all nature's arrangements, and the unerring actions of her laws is exhibited in her method of developing man. He is carniverous, hence combative; gregarious, therefore social. This is equally true of individuals and of nations. If we follow out this thought, we shall find man, even in his perturbations, is a creature of law.

All matter is similar in substance, differing only in degree of development. The refinement of matter is a process ceaselessly going on in the Eastern as well as in the Western hemisphere; for the parental law of physical and mental formation, and progressive development is universal, coëxtensive and coëval with nature, No solitary world or people has a special code of laws. God, the controlling power, is law, impartial and universal. Man is the highest physical ultimate of matter endowed with a progressive principle. To him, religion is a grand, progressive, moral science, unfolding his physical and mental qualities by exact and eternal law. It everywhere teaches him that the aspect of all created things is continually changing, and in obedience to law he *must advance*, for all present conditions periodically perish. With constantly changing conditions, an endless evolution of forms and ideas is ceaselessly occurring.

Nature is everywhere instinctive with life; attractive and repulsive forces are exerted over atoms and bodies, and equally over minds. These, in the latter case, influence migrations. Capricious influences often intervene to determine direction; for nature works by greater or lesser impulses, yet her methods determined by law, are always adapted to the end in view, to the plan of the Great Architect, the Intelligent Mind of the Universe.



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In all subdivisions of races, we are apt, at first, to look superficially upon different nations as separate and complete types of humanity. The brief synopsis here collected from ancient histories, clearly reveals the extent of maritime interoourse, actually developed by western nations up to fully 4,000 years ago. By such statistics, acquired with sufficient details to trace facilities for admixture, the inference fairly follows: that maritime nations of Asia, including the Japanese, whose origin we are soon to examine, may have enjoyed like facilities of intercommunication; and consequently, in common with all maritime peoples at this stage of human existence, became to a certain extent mixed and composite.

Until we reflect, we know not the possibilities of human nature. The exact justice of all nature's arrangements, and the unerring actions of her laws is exhibited in her method of developing man. He is carniverous, hence combative; gregarious, therefore social. This is equally true of individuals and of nations. If we follow out this thought, we shall find man, even in his perturbations, is a creature of law.

All matter is similar in substance, differing only in degree of development. The refinement of matter is a process ceaselessly going on in the Eastern as well as in the Western hemisphere; for the parental law of physical and mental formation, and progressive development is universal, coëxtensive and coëval with nature, No solitary world or people has a special code of laws. God, the controlling power, is law, impartial and universal. Man is the highest physical ultimate of matter endowed with a progressive principle. To him, religion is a grand, progressive, moral science, unfolding his physical and mental qualities by exact and eternal law. It everywhere teaches him that the aspect of all created things is continually changing, and in obedience to law he *must advance*, for all present conditions periodically perish. With constantly changing conditions, an endless evolution of forms and ideas is ceaselessly occurring.

Nature is everywhere instinctive with life; attractive and repulsive forces are exerted over atoms and bodies, and equally over minds. These, in the latter case, influence migrations. Capricious influences often intervene to determine direction; for nature works by greater or lesser impulses, yet her methods determined by law, are always adapted to the end in view, to the plan of the Great Architect, the Intelligent Mind of the Universe.

Perfect arrangement and maturity of plan marks the order of creation. Life is to unfold, cultivate and develop our rudimentary powers. Every atom bears its own record. Our own soul is the parchment, whereon is indelibly engraved our virtues and our vices. Action and rest succeed one another. Periods of intense activity are succeeded by others, either dilatory or inert, when action gradually subsides. The world is now entering a period of great popular activity.

Language is inadequate to convey a perfect idea of a spectacle, open to the analytical eye of every observing naturalist; sublime as it is wonderful, exact as it is impartial. All things are subservient to exact law, and similar conditions lead to similar results. An elementary study of the early intercourse among so-called western nations, seems imperative to those who would seek to unravel a corresponding movement among aborigines of the far East.

The independence of thought and action, which this age has developed, precludes the acceptance of any theory by the educated classes, which is not in accordance with nature and reason. Only by practical illustrations can we properly comprehend nature's intricate principles and processes. Science says: prove all things, all truth is susceptible of proof.

Although many individual instances here quoted may be familiar to scholars; their ethnological value is especially apparent when massed in one collection, where they show early intercourse to have been habitual rather than exceptional, revealing the probability as well as the possibility of very early admixture of races, and finally elicit testimony to establish a certainty.

From the earliest dawn of human history, tribes and nations appear to have been more or less mixed, either when captured as prisoners of war, like the Sabine women of Rome, or united in friendly alliance for purposes of commerce. General communication, here shown to have extensively occurred during the early stages of human development, naturally implies that all early races brought in contact by commerce, have to a certain extent, mutually left their impress upon each other.

Before submitting the ancient records of Asia to a scrutinizing search, we briefly trace the early footsteps of national intercourse in the histories of western nations. Gradual progression marks the development of commerce, from the rude attempt of the ancients to follow their coast with primitive galleys, having solitary mast and sail, or oars double or treble banked, to the dauntless energy of ocean steamships at the present day. Slowly but surely commerce is raising inventive genius above the fame of military chieftains, and enabling Watt, Fulton, Arkwright, Whitney and Morse, to claim a greater share of our true admiration, than agents of destruction like Alexander, Cæsar or Genghis khan.

Maritime commerce, which exchanges what a nation can spare from its abundance, for what it wants, is of very ancient origin, and may have had its beginning in the unrecorded era, nearly coëval with the development of intelligence in man.

The study of astronomy, a science essentially necessary to ocean navigation, was very ancient among oriental nations. Learned astronomers are persuaded that the celestial observations of the Chinese were accurately taken B. C. 2249; those of an eclipse, B. C. 2155, have been proved as authentic, and

other observations are recorded three centuries later. Astronomical observations made at Babylon, calculated the rotundity of the earth, which they estimated at 40,000 miles in circumference; and those when transmitted to Greece by Alexander, and seen by Aristotle, B. C. 324, contained a calendar of above nineteen centuries, extending back to within fifteen years of those ascribed to the Chinese. Europeans first learned this science from Jupiter Belus, king of Babylon. The ancient kingdoms of India appear to have had observations fully as early as the Babylonians.

We will now attempt to trace chronologically the naval growth and ancient commerce of western nations by their records, from B. C. 2249 to the Christian era, to demonstrate the possibility of early migrations of races in prehistoric times. Migrations by water, which appear by our own histories to have occurred around the Mediterranean, may likewise have occurred on the Pacific, and in other parts of the habitable globe. Shore lines and water courses were early availed of for the distribution and subdivision of races. Mountain ranges were natural barriers.

The authenticity of ancient history necessarily rests upon the evidence of ancient writers, when unimpaired by later discoveries. This summary has therefore required a judicious digest of many original authors, from whom its statistics are compiled and arranged.

Few seem to be aware of how early and extended an intercourse existed between Asia and the western world, which in its earliest ages was principally conducted by the South Arabians, a people apparently more enlightened by science and commerce than any nation farther East except the Phœnicians.

The South Arabian commerce is supposed to be the most ancient intercourse between far-distant peoples, of which western nations have any remaining records. That next in importance, and apparently also in order of time, was that of the Phœnicians and their colonies, especially Carthage and Gadir (changed by the Saracens to Cadiz). Those general enemies of commerce, the Romans, soon abolished that of Cathage and of Corinth. With the increase of the Roman empire came the decrease of commerce, excepting only that branch necessarily enlarged by an increasing demand for Oriental luxuries. Of this very early trade of the Europeans and nations of Asia Minor, with the Orient, we happily possess a description which, for accuracy and minuteness of detail, when compiled, may almost rival a modern official account.

As the Roman empire declined, the Oriental trade, supported merely by the redundant opulence of Rome, gradually decayed; and in the sixth century we find the intercourse with India turned into a new channel. During the many dark ages which succeeded the subversion of the western empire, gross ignorance prevailed, and commerce, in common with literature and science, became neglected in the western hemisphere, until renewed attention was drawn to it by the Saracens, and at some of the Italian seaports. The spirit of commerce afterwards arose in the Netherlands and at some German seaports, followed by Portugal and Spain, and latterly by Great Britain and other European nations.

The Greeks esteemed Phœnicians as the inventors of commerce, shipbuilding, navigation, and the application of astronomy to nautical purposes; their

capital, Sidon, founded about B. C. 2200, became preëminently great and illustrious for the wonderful energy of its people, but it is presumed that commerce was received by the Phœnicians from the Babylonians, and in turn found its way there from Indian countries farther East, along the Asiatic shore and Malayan archipelagoes.

That Persian poem, the book of Job, generally admitted to be the oldest book in the Hebrew bible, shows that sciences were then cultivated, ship-building, useful and ornamental arts, were in an advanced state, and commerce was vigorously prosecuted. Vessels are spoken of as distinguished for their speed, bringing gold from Ophir, and topazes from Ethiopia.

B. C. 1728, the Arabians conducted an extensive and profitable trade between Egypt and India, importing largely of spices, gold and silver; and it is recorded, B. C. 1556, that vessels were propelled by fifty oars. This custom continued, and in later history we find their size increased, and they were furnished with three, and at times five, tires of oars.

The early history of Greece shows their vessels were Phœnician built, rowed by oars—long, slender, open boats, lightly constructed, capable of being transported upon shoulders, the smallest carrying 50 men, the largest 120—and although they had masts and square sails, they depended mainly upon their oars. Seventy geographical miles was considered a day's work for a vessel with oars, and the sailors were paid four *oboli*, or about eight cents a day.

Much of the early Greek mythology came originally from India. There is scarcely anything the Greeks ever learned from the far Orient, the invention of which they have not ascribed to their own countrymen. Many of our best scholars, aided by recent discoveries and researches, are now persuaded that the use of letters was known to the Greeks before Cadmus came from Phœnicia, B. C. 1556. The earliest letters known in Greece were more probably those which Plato calls Hypoborean (i. e. northern), and describes as different from letters of his own age. According to Diodorus Siculus, Orpheus used Pelasgic letters, which were older than the Greek.

Strabo says: the invention of rafts, the very first rude essays in navigation, was ascribed to Erythras, a king of some part of the coast of the Persian Gulf. Theophrastus is, I believe, the oldest author who alludes to cinnamon and other spices and aromatics, knowing them to be the produce of India. Intercourse between India and Arabia was easy by availing of the monsoons, whose periodical regularity were observed and taken advantage of, to bring cargoes of spices many ages before the time of Hippalus, whom the Egyptian Greeks supposed to be their first discoverer. The Southern Arabs traded to more remote parts of India than the Persians or Assyrians, and from the earliest ages enjoyed most generally the entire monopoly of the trade between far India and the western world. It was not until Europeans found an ocean route to India via the Cape of Good Hope, that the ancient system of their most important commerce was totally overturned.

This commercial history is quoted as showing how common and easy was the migration of colonies by sea in remote ages, and how great an ascendency the possession of shipping and maritime power gave to some of the pre-historic races. In very early times the Phœnician merchants were the greatest

ocean carriers for the whole western world. B. C. 1280, the spirit of trade is recorded as having spread over the greater part of Asia.

The religion of Egypt declared the sea unclean, because the dead body of their god Osiris was thrown into it. Egyptians therefore abhorred the sea, and formerly avoided any concern in maritime affairs. Their early trade was conducted by foreigners; on the Mediterranean and with Arabia, their commerce was for a long time wholly entrusted to the Phœnicians. According to Apollonius Rhodius, B. C. 1300, and prior to the expedition of the Argonauts, Sesostris, king of Egypt, built a fleet of 400 vessels on the Erythræan (Red) Sea. The Egyptians were, however, but fresh-water sailors; their hulls and masts were made of *thorn*, and sails of paper.

The Greeks had skillful ship-builders, and Homer has immortalized Harmonides as the builder of the vessels which carried off the beautiful Helen from Sparta. During the "heroic ages" of Greece, the petty princes on the sea coast frequently fitted out vessels to go on piratical cruises against the merchant ships upon the Mediterranean; hence it became common to question a commander whether he professed piracy or trade.

Their course depended on the previous knowledge of the shore acquired by some member of the crew. Homer describes Ulysses as covering his ship with long planks, making probably a half-deck.

B. C. 1194, when Paris carried off Helen, wife of Menelaus, king of Sparta, Agamemnon, king of Argos, embarked a Grecian army of 100,000 men in a fleet of 1186 vessels to avenge the affront.

Castor, of Rhodes, a writer cotemporary with Julius Cæsar, made a catalogue of nations who successively attained the empire of the (Mediterranean) Ægean Sea. B. C. 1280, the island of Crete was called by Aristotle the Empress of the Sea. B. C. 1179, the Lydians, after the Cretans, were honored by Minos with the title of masters of the sea. B. C. 1058, the dominion of the sea is ascribed to the Pelasgi. B. C. 1003, Castor alleges the Thracians had the *Empire of the Sea*, and held it 19 years. B. C. 890, the dominion of the sea is ascribed to the Phrygians. B. C. 753, the Milesians are represented as supreme in naval power, and having a wide commercial fame. B. C. 734, the dominion of the sea is ascribed to the Carians, buccaneers, noted for their piracies. B. C. 717, the Corinthians, a nation of Greece, made a considerable figure in naval transactions. Thucydides mentions their naval force soon after the Trojan war, kept up to protect their trade against pirates. B. C. 676, the Lesbians obtained and held command of the sea for 59 years. B. C. 67, the Romans were masters of the sovereignty of the sea without a competitor, having destroyed nearly all the mercantile nations.

B. C. 1100, the Phœnicians extended their discoveries along the entire northern coast of Africa and the opposite shores of Spain. The Mediterranean was no limit to their enterprise, for they passed the Pillars of Hercules (Gibraltar) and established powerful commercial settlements upon the Atlantic, mutually beneficial to themselves and natives of the country. Phœnician colonies were societies of opulent and intelligent merchants, ingenious manufacturers, skillful artizans and hardy seamen, who left an overcrowded population, with the good wishes of their parents and friends, to settle in a distant country and there maintain a correspondence for mutual advantage.

B. C. 1046, Eupolemus says David built ships in Arabia, wherein he sent men skilled in mines and metals to the island of Ophir.

B. C. 1012 and 975, Solomon extended his territories to the Red Sea, and despatched ships to the rich countries of the South and far East. Hiram, king of Tyre, wishing an opening to the rich commerce of the Orient, either acted in partnership or concert with him.

Previously all Oriental products had been received at second-hand through the Arabians. Solomon's ships, built and conducted by the Tyrians, sailed in company with those of Hiram to the rich land of Ophir and Tarshish. A voyage required three years to accomplish, and the returns were prodigiously profitable, consisting of gold, silver, precious stones, ivory, woods, apes and peacocks. They probably availed of the monsoons to visit Ceylon, Sumatra, India, and possibly communicated with China and Japan. The Phœnicians, when in the Indian Ocean in company with Solomon's fleet, doubtless saw the beautiful Malay prows, and reported and improved upon the former models of their vessels, and multiplied their oars or paddles.

B. C. 916, the Rhodians composed a Code of Maritime laws, which was copied by the Romans, and ingrafted into the law of Oberon, which is in a great measure in force to this day. They were of Phœnician origin.

B. C. 890, the Greeks received from Asia coined silver money, weights and measures.

B. C. 717, the commercial city of Tyre was attacked by Salmanasar, king of Assyria, who brought against it a fleet of 70 vessels, furnished and manned by Phœnicians. The Tyrians defeated this fleet with only 12 ships, and took 500 prisoners. This is the most ancient naval battle recorded in European histories.

B. C. 700, great improvements were introduced into shipbuilding by the Corinthians.

B. C. 641, Colæus, of Samos, sailed through the Straits of Gibraltar to Tartessus on the southwestern coast of Spain, and was the first Greek who ever saw the Atlantic.

B. C. 616, Necos, king of Egypt, sent a fleet of discovery to circumnavigate Africa, engaging therefor Phœnician navigators who sailed by the Red Sea, and following the coast of Africa, returned by the Mediterranean, reaching home the third year after their departure.

B. C. 594, according to Diodorus Siculus, Apries, king of Egypt, had a fleet on the Mediterranean, and fought a naval battle against the maritime cities of Sidon and Tyre, the former of which he captured, beating the fleets of Phœnicia and Cyprus, and returned to Egypt loaded with spoils. As Egypt had no ship timber, most of the Egyptian fleets were built by, and purchased of, the Phœnicians.

B. C. 588, The Tyrians employed workmen from all neighboring countries to labor in building and navigating their ships, which were magnificently adorned with ivory, purple and fine linen; their commanders were most respected, and every commercial and maritime calling was esteemed honorable.

About this time, Thales, a Greek philosopher descended of Phœnician parentage, pointed out to the Greeks the *Ursa minor*, by which Phœnicians steered their course at night; instructed them in the rotundity of the earth; fixed the year into 365 days, and predicted the year of an eclipse.

Pythagoras, a native of the island of Samos, taught the rotundity of the earth, the existence of the antipodes, and a confused idea of the real motion of the planetary system as afterwards demonstrated by Copernicus.

B. C. 550, the Phœnicians visited Ireland, and returned with reports of the islands now known as Great Britain.

B. C. 543, we learn that the inhabitants of Phocæa, a Grecian city on the Asiatic coast, were a commercial people, and the first Greeks who traded to remote Asiatic countries; performing their voyages in long vessels of fifty oars, in the management of which they were very expert. Strabo mentions a colony of Phocæans who were expelled from Corsica, who sailed to the south of Gaul, where, B. C. 538, they founded Massilia (Marseilles), a city which about the Christian era, sustained a high character as the seat of science, commerce and naval power.

The Etruscans and Etrurians, says Didorus Siculus, founded colonies at a very early age, were good mariners, and appear to have possessed the greater portion of Italy before the Trojan war. Polybius says, B. C. 524, the Carthagenians were possessed of hereditary preëminence in nautical science. Their ships were equal to any on the Mediterranean, carrying carved figure heads and sterns. Aristotle says they were the first who raised their ships of war from three to four rows of oars. They constructed wet docks, and were first to appoint second captains (mates) to their vessels.

B. C. 524, the Carthagenians embarked 30,000 people in sixty ships of fifty oars each, and passed Gibraltar to the west coast of Africa to found colonies. These vessels must have carried 500 persons each.

B. C. 506, Darius, king of Persia, invaded the Scythians with a fleet of 600 vessels. Darius was also sovereign of Phœnicia.

B. C. 497, the Ionian fleet of 353 vessels was defeated by 600 ships belonging to the maritime vassals of Persia, chiefly under the direction of Phœnicians.

B. C. 494, an expedition, conducted by Mardonius, son of Darius, composed of 300 ships, containing 20,000 soldiers, was cast away against the rocks of Mount Athos during a violent storm.

B. C. 481, Xerxes, the mighty monarch of Persia and a greater part of Asia, sent a memorable expedition against Greece, composed of 1,207 *triremes*, or ships of war, carrying three *tires* of oars, and 3,000 transports, which formidable armada was finally defeated by the Greeks.

B. C. 477, Herodotus says, Amilcar a Carthagenian general, invaded Sicily with an army of 300,000 men. As Sicily is an island, this necessitated a naval fleet.

Frequent mention of large naval fleets transporting armies, is made from this date until the Christian era. From this time wide commercial intercourse existed, and many naval engagements of great magnitude are noted.

The commerce which had flourished for ages in the hands of the Phœnicians was largely desolated by the conquests of Alexander, B. C. 333.

B. C. 260, the Romans, who prospered for a while by a perpetual violation of justice, resolved to establish a naval force for piracy and commercial plunder. They had neither ship carpenters nor seamen, but got possession of a stranded Carthagenian *quinquereme*, and in sixty days from felling the trees,

their carpenters had constructed a fleet of 100 quinqueremes and 20 triremes. Roman sailors were drawn from the despised classes of the populace, and were unrespected, while the navigators and seamen of Tyre and Carthage were held by their people in high and deserved esteem.

B. C. 242, although the Romans had considerably improved in nautical knowledge, the progress of Science among them was very tardy, and their losses by storms at sea were prodigious. In one gale almost every soul perished on 384 of their ships, which either foundered or were wrecked. At the same time the Carthagenian fleet made a good harbor and escaped damage. The haughty Romans thought commercial concerns beneath their dignity, and that extended selfishness which they called patriotism, soon rendered it impossible for any mercantile nation to flourish within the grasp of Rome.

B. C. 219, superabundant wealth induced a rage for shipbuilding, among Hiero, king of Syracuse, and other opulent kings of his age, vastly exceeding every purpose of utility in enormous bulk and extravagant ornament. Assisted by Archimedes, Hiero constructed a galley of twenty tires of oars, sheathed with sheet lead, and carrying three masts, which no vessel had hitherto done. She had the embellishments of a palace with the fortifications and warlike stores of a castle. Athenæus tells us, on the authority of Callixenus and Mosepion, that Ptolemy Philopator, king of Egypt, built two huge ships. One intended for sea service was 420 feet long, 57 feet beam, consisting of two long flat vessels united by one deck, having two heads and two sterns. She carried 4,000 oars, disposed in 40 tires. Besides 4,000 rowers, she carried 2,850 soldiers, cooks, servants, etc. The other vessel, intended for inland navigation, was 300 feet long and 45 feet beam.

B. C. 170, the Sabæans, who possessed the southern extremity of Arabia, acquired great opulence by commerce, and preserved their liberty unimpaired by conquest during many ages. Agatharchides says they were in possession of the carrying trade between Asia and Europe, and commanded the commerce of both. They filled the dominions of Ptolemy with gold and silver and precious stones (probably from Ceylon), and founded several colonies in foreign countries.

B. C. 146, the Romans, determined upon the total abolition of commerce, destroyed the mercantile city of Corinth, and thought themselves entitled to the exclusive privilege of plundering the world.

B. C. 100, Strabo repeats a story of a vessel from India, picked up adrift in the Red Sea, with only one man aboard, almost dead, whose shipmates died of famine, and Ptolemy Eurgetes, II, king of Egypt during the Macedonian dominion, sent Eudorus to convey him back to India, whence the expedition returned with aromatics and precious stones.

B. C. 67, Pompey, with 500 Roman ships under his command, captured 400 ships at Cilicia.

B. C. 66, Lucullus, returning from Asia, brought as a part of his plunder, a large number of books.

B. C. 57, the Veniti, said by Strabo to be a Belgic nation, settled near the northwestern extremity of Gaul (France), were distinguished for their nautical science and experience. They had great numbers of vessels, excellent sea-boats, used leather sails, and iron chains instead of rope cables, and car-

ried on a considerable trade with Britain. Their fleet of 220 such vessels was overpowered and captured by a Roman fleet of 600 galleys.

B. C. 54, Julius Cæsar collected above 800 ships and landed a large force in Britain, subduing a great many kings, four of whom were in Kent.

B. C. 43, the profusion of luxury introduced into Rome by the conquest of enervated kingdoms of Asia, had now made alarming progress.

B. C. 25, ambassadors are said to have been sent by an Indian prince called Porus, from India to Rome, and, according to Florus, also from the Scythians, Sarmatians, and even the Seres, to court the friendship of Augustus, who was then in Spain. Those from India were nearly four years upon their journey. Augustus was called the father of the Roman imperial navy, of which Ravenna on the Adriatic was the principal eastern station, and Misenum in the gulf of Naples, the western. Pliny says, in his reign some Roman navigators explored the coast of the North Sea as far as Cimbri (the north end of Denmark). At this time the Britons used small vessels of which the keel and principal frame was made of light wood, the bottom and sides of a kind of basket work made of osiers, and the whole was covered with hides.

The Arabians, who furnished the greatest and most reliable part of articles imported into the Mediterranean, appear to have been the only traders from the West, whose voyages in very early days extended to India. In 1851, I met a small native Arabian vessel far from land in the Bay of Bengal, bound towards the Spice Islands of the Malay Archipelago—a notable relic of ancient times. People of such commercial and nautical knowledge as the South Arabians, could not have experienced the semi-annual changes of the monsoon, without early availing themselves of the advantages they offered to their navigation. It would by no means be extravagant to suppose that they traded to Taprobanè (Ceylon), or even to countries and islands far beyond it. As early as the days of Solomon (B. C. 1000), no such spices were known in Jerusalem as those presented by the Queen of Sheba; and later we learn in the days Ptolemy Philadelphus, B. C. 280, the Sabæans, whose long experience in the nature of the periodical winds called monsoons, of the seas and various ports of India, undersold the merchants of Egypt, who coasted the whole way to India in their own small vessels. Ptolemy sent Dionysius to India as Ambassador, with a view of establishing direct intercourse with that country.

In the "Periplus* of the Erythræan Sea," oriental vessels then in use are thus described: *madaratæ*, small vessels joined together by sewing; *trappaga* and *kotymba*, long vessels used by fishermen and pilots; *sangara*, piratical crafts like double canoes; and *kolandiophonta*, which vessels were of the largest size, with capacity to perform distant voyages, and were in the trade of Arabia, with the river Ganges, and countries beyond it. This work which, for approved accuracy of geographical, nautical and commercial information, stands unrivalled by any production of antiquity, comprehends under the name of the Erythræan Sea, all the ocean between Africa and

*The PERIPLUS (circumnavigation) was written about the first century of the Christian era by an Egyptian Greek, an intelligent merchant and practical navigator upon the Erythræan Sea.

India, including the Bay of Bengal. It observes that the unexplored ocean extends to the southward until it joins the Atlantic, information generally concealed from the age of Necos, B. C. 616, until the re-discovery of the Cape of Good Hope by the Portuguese in the fifteenth century.

Some authors say that Solomon's ships circumnavigated Africa and returned by the Mediterranean laden with gold. More likely they availed of the monsoons and went to Ceylon, India and Sumatra.

The Seres, described as the most remote people of Asia known even by report to the Europeans, are said to have manufactured sericum or silk garments from threads finer than those of the spider, which they combed from (cocoons like) flowers. Nearchus, the admiral of Alexander's fleet, speaks of this precious manufacture which found its way to Rome in the days of Cæsar, and being a monopoly and subject to a long succession of tedious and dangerous sea and land carriages, sold at a price making it equal in value to gold. Seres also shipped to Arabia steel much superior to all other kinds, the product of a country in the eastern part of Asia. White rock candy and porcelain such as is produced in China, was also shipped, and all these bore the expense of a succession of land and water carriages. May not the steel have come from Japan and the porcelain from China? When the Portuguese arrived on the coast of Asia in their first voyages of discovery, they found it frequented by vessels of various nations.

The natives of India, deriving all the necessities and enjoyments of life from their fertile soil and own industry, cared very little for productions of the West. Grecian merchants were obliged to pay for their cargoes chiefly in money, and Pliny says, that at the lowest computation, 500 sestertia (equal to £403,645 16s 8d sterling) was every year sent out of the Roman empire for the purchase of goods, which were sold in Rome at an advance of one hundred for one. A sum equally large was also paid to Arabian merchants for articles from their country of mere luxury and female vanity.

The increasing demand of almost the entire Roman empire for Oriental luxuries, all of which when crossing Egypt in transitu paid especially heavy import and export duties, increased the revenue of that country immensely; some idea of which is given us by Appian, who says Ptolemy Philadelphus at his death, left in his treasury 740,000 talents, (equal to £191,167,666 13s 4d sterling), much of which, however, may have been derived from the plunder looted by his father from the Persian empire.

In thus glancing at the early records of ocean navigation among the Arabians, Phœnicians, Greeks, Hebrews, etc., we discover the important position occupied by the Phœnicians, as the principal supporters of an early and extended intercourse with the Orient. We may draw some analogies therefrom in a future outline of the early commerce of Asiatic nations, among themselves, and their intercourse with the American continent in very early times. All these movements of peoples have an important ethnological bearing, as revealing the possible methods of migrations along the shore-lines of countries.

From early maritime records here cited in illustration, we are led to infer that intercommunication by water, along coast-lines, was very ancient among all western nations at a very early period, and we are persuaded that all

commerce was then in connected circles, like links of a chain; each orbit of trading fleets communicating at its extremes with others farther east and west. Thus the silk of China and Japan, unknown in Europe, found its way into ports on the Baltic Sea, through several limited districts of trade, each keeping within its natural limits, but acting as a medium for circulating the products of one extreme to the other. All trade being more or less a monopoly, the point of production of many valuable commodities was frequently concealed.

Certain terminal points exist in all trade where one system of commerce links into and connects with another reaching beyond. Such were Gadir, Massilia, Alexandria, Tyre, Sidon, Taprobanè (Ceylon), Molucca, Seres, etc.

Thus legends and traditions of far distant countries were communicated in advance of their discovery, and although at first deemed mythical, were generally founded on facts, and largely confirmed by later discoveries and explorations in the field, and since found fully detailed in Oriental histories yet extant. Every variety of enormity has in all ages been the characteristic ascribed by ignorance to unknown nations, and these have been gradually removed farther and farther as discovery advanced.

Great numbers of people were distributed by this early commercial enterprise, and how large indeed must have been the number of ancient Phœnician and Malay wrecks, if the Japanese wrecks of the present day may be accepted as any criterion. Nature is universally consistent.

In future papers I shall discuss the different origin of the Chinese and Japanese races, and conclude by expressing the opinion that early races have been far more spread and intermixed by early maritime intercourse, than the casual observer would suppose, and that, however distinct any type of mankind may appear, all will be found to be more or less composite, excepting, perhaps, some remnant of early aborigines, driven into a forced seclusion among the fastnesses of interior mountain ranges.

The authorities adduced in this paper might be greatly increased, but I have studied to be as brief as possible, aiming only to show the progressive quality and universality of natural law, whereby analogical reasoning is rendered comparatively safe, and to *establish the fact of early intercourse* among maritime nations of the West, rather than to fully illustrate either, by elaborate details.

Dr. Brigham read an invitation to attend the International Congress of Americanists, to be held at Nancy, France, July 22, 1875.

Judge Hastings called the attention of the Academy to the fact that the work of the State Geological Survey on the "Botany of California" would shortly be published. As the flora of the Pacific Coast develops some characteristic species, novel and interesting, worthy the attention of the students of this science, it is highly to be desired that the work on the botany of this State should be published. This publication is now secured

through the exertions of D. C. Gilman, President of the University of California, at whose request the following named gentlemen have contributed the necessary funds to put the work in stereotype: Leland Stanford, Henry Pierce, R. B. Woodward, Lloyd Tevis, D. O. Mills, J. C. Flood, John O. Earl, Wm Norris and Chas. McLaughlin. These gentlemen are not known to be scientists, and do not appear to be actuated by any special or personal motive. The California Academy of Sciences, therefore, in recognition of their generosity, orders that their names be enrolled upon the records of the Society as benefactors of Science.

And it is deemed proper that honorable mention should be made of Professor Asa Gray, Professor J. D. Whitney, Professor Watson and Professor W. H. Brewer, for their personal devotion to the work without pecuniary consideration.

The Secretary was ordered to incorporate the above remarks in the minutes.

Regular Meeting, April 5th, 1875.

Vice-President Edwards in the chair.

Sixty-five members present.

Donations to the Cabinet: From Chas. D. Gibbes, bird's nests from San Joaquin County; from Mr. Frink, collection of grasses, bark and nuts from Hawaiian Islands; from Professor George Davidson, a collection of Japanese plants.

Horatio Stone read a paper on the Unity of Arts.

Amos Bowman read a paper on Coal Deposits of the Pacific Coast.

Professor Brewer exhibited a map showing the distribution of woodlands in the United States. In speaking of the map he alluded to the theory of the connection of the existence of forests with rainfall. In the investigations of the Smithsonian Institution, no instrumental evidence had been found, in any part of the United States, that the destruction of forests had re-

duced the rainfall. The fact appears to be so, but has not been properly proven.

Dr. Gibbons did not agree with Professor Brewer, and thought there was evidence to prove that there was a connection between the existence or non-existence of forests and rainfall. In California, in regions very limited in extent, the rainfall varies greatly in a few miles, the greater amount falling in the vicinity of timber.

Dr. Gibbons exhibited a branch of poplar tree on which a piece of misletoe had grown in a peculiar manner. It came out from the end of the broken branch as if it had been grafted.

Regular Meeting, April 19th, 1875.

In the absence of the President and Vice-Presidents, John Hewston, Jr., was called to the Chair.

Fifty members present.

The following new members were elected: Alfred E. Regensberger, Jas. B. Clifford, E. T. Tarbox, Arthur C. Taylor, Chas. Frances, J. R. Stanton and F. P. Hartney.

Messrs. S. B. Christy and Frank Soulé were proposed for membership.

Donations to the Museum: From Professor Gustaf Eisen, University of Upsala, Sweden, two specimens of *Pinus flexilis* in foliage, two cones and foliage of the sub-alpine form from Mono Pass, former 12,000 feet, latter lower; also *Ephedra antisyphalitica* and *Abies Pattoniana* (Williamsonii) from same locality. W. G. Blunt donated silky poppies of an unknown plant used in stuffing birds; Joseph H. Clarke, of Cahto, Mendocino County, California, presented specimens of salmon trout. From T. J. Butler, Arizona, specimen of curious insect captured in Agua Fria River, Arizona.

Professor W. H. Brewer read the following:

On the Formation of Ice-pellets or Hail, in the Spray of Yosemite Fall.

BY PROFESSOR W. H. BREWER.

On Wednesday last, April 19th, in company with Mr. Galen Clark (under the Commissioners, custodian of Yosemite Valley), I visited the foot of the upper Yosemite Fall. In the winter, a great *ice-cone* forms in front of this fall, mostly, it is probable, an accumulation of frozen spray. It is now much reduced by thawing from what it was a month ago. At our visit, it extended below the fall several hundred feet, bridging the chasm to an unknown thickness. The two persons most familiar with it, respectively estimated its thickness that day at "sixty to one hundred feet," and "nearer two hundred feet." The outer side of this "cone" slopes away from the fall; the inner side rises like a wall in front of the sheet, which falls mostly behind it with deep, thunderous sound; the water flows beneath the mass, and emerges from an icy arch at its foot, which arch in shape and appearance strongly reminds one of the ice-arch in the foot of the glacier at the source of the Arveiron, at Mt. Blanc.

The stream was so high from the melting of the snow, that it dropped from the extreme top, not clinging to the rounded crest, as it does when the water is lower, but leaping out so that the actual leap is perhaps fully 1550 feet to the rocky bottom, and to the top of the "ice-cone," nearly or quite 1500 feet. Over the ice-cone the spray is furiously driven by the powerful air-blast produced by the fall.

The day was warm and clear, the time of observation between 12 M. and 12.30 P.M., and the fall in its brightest illumination, as it faces nearly south. As we neared the ice-cone, certain appearances suggested to me that the spray which drifted over it was (in part, at least) snow. To examine this, we ventured on this cone farther than strict prudence dictated, and in the tempest, which stung our hands and faces like shot, we found the spray in part to be *hail*, or *ice-pellets*. The exact character of these pellets could not be studied in the blinding blast to which we were subjected. They appeared to be hard, like hail-stones, tolerably uniform in size, and I estimated them at about one-tenth of an inch in diameter. They accumulated quite copiously on our clothes, but most so towards our feet, as if they were most abundantly hurled along near the ice on which we stood. They also accumulated in thin sheets on the rocks which rose through the ice near its edge.

The ice-cone, which had been very white during the winter, had been sullied by sand and dirt carried over it with the spray in the heavy storm of the previous week. Near its lower edge, however, were many depressions filled with what appeared to be new and pure snow, which we believed to be in reality fresh accumulations of these ice-pellets, but from their position it was impossible to examine them. We however pushed our way back to the rocky

wall beside the fall and as near the sheet as it was possible to breathe or to stand. If any of the pellets occurred there, I could not prove it. I could not feel them, and the water so blinded us that nothing could be seen distinctly. On returning, we kept on the rocks, and noticed none of the ice-pellets there. I had left my thermometer behind, and had no means of testing the temperature of this freezing blast.

At Leidig's Hotel, which is one and three-eighths mile distant and about a thousand feet lower, my thermometer stood at about 52° Fahr. at 6 A.M.; 78½° at 2.30 P.M.; 79° at 3.15. P.M.; 58° at 9 P.M., and 50° at 6 the next morning. I had no *wet-bulb* to determine the dryness, but that the air was very dry was shown by the rapidity with which our saturated clothes dried.

When this fall was visited by the State Geological Survey in June, 1863, the idea was suggested that we examine the temperature of the water above and below the fall, to see if any actual heating of the water occurred as a result of its concussion after falling from so vast a height. The dryness of the air was then so great that I was convinced that evaporation would counterbalance or at least vitiate any results that might be theoretically based on the mechanical equivalent of heat, so the experiment (which would have cost much labor and time) was not tried. And on seeing this new phenomenon, the hypothesis which immediately suggested itself to me as an explanation was that it was due to evaporation. That the fall is fed by melting snow, much of which still lies near its top; that the great volume of ice-cold water chills the adjacent air to near 32 degrees; that the air-current thus cooled, as it is drawn into and along with the immense descending mass, is a very *dry* current, and that its rapid saturation by this evaporation of a portion of the spray is sufficiently chilling to freeze drops of water up to a certain diameter. Had the ice-pellets been portions of the ice-cone torn off from its edge and hurled outward with its spray, we would not expect such an uniformity of size as I observed.

Professor John LeConte, on my describing the phenomenon to him to-day, has suggested another hypothesis, more plausible, perhaps, than mine. It is that the air carried down and cooled by the water is somewhat condensed at the base of the fall, and that by its expansion as it gets away from the pressure, sufficient cold is produced to freeze the drops.

Whatever may be the explanation, of the *fact* there is no mistake.

T. J. Lowry read the following paper:

Hydrographic Surveying.

BY T. J. LOWRY, U. S. COAST SURVEY.

Hydrographic surveys of bays, lakes, rivers, gulfs and the parts of oceans adjacent to coasts, are indispensable requisites to a safe navigation, and hence successful international commerce. Being of national importance, they are therefore national undertakings—and the Government Coast Surveys and

navies of all countries are engaged in determining and mapping the topography of the water basins and channels of the earth.

An accurate survey of waters adjacent to land is based upon a survey of the adjoining lands, by means of which the figure of the coast and the positions of a sufficient number of conspicuous and well-defined objects near the coast have been ascertained. These objects are the landmarks, by observations of which the positions of points on the surface of the water (and hence the soundings) are determined. The relative positions of the landmarks are ascertained with a degree of accuracy proportionate to the character and extent of information to be given by the chart. When perfect accuracy is aimed at, many stations on shore (and especially on island shoals and reefs) are first determined usually by a trigonometrical survey whose accuracy is tested by a base of verification. The stations in the triangulation being selected with reference to the ultimate ends in view (viz., the wants of the hydrographer and navigator), will be so chosen as to include or determine light-houses, headlands, and other remarkable objects—not allowing the triangles, however, to depart too much from the well conditioned forms. In making choice of stations, and thus giving shapes to the triangles, it is well to remember, that where *all the angles are to be observed*, the condition most favorable to the accuracy of computation—i. e., where instrumental errors and errors of observation will least affect the determination—is where each triangle is equilateral. But where *two angles only are to be observed*, the unobserved angle should be a right angle, and the observed angles equal to each other and never less than twenty-five or thirty degrees. Experience proves that, in well conditioned triangles, the small errors made in the measurement of the angles do not accumulate through each successive step in the operation, but on the whole tend to compensate each other.

Whatever extent of coast may be surveyed, each series of hydrographic operations will be confined to comparatively limited spaces, and the whole will consist of numerous detailed charts correctly linked together and harmonized by means of the triangulation on shore; a description, therefore, of the *modus operandi* in making a hydrographic survey of a single harbor or short sea reach will apply equally to the system adopted in the survey of an extensive line of coast.

Having made a reconnaissance of the region to be surveyed, and gathered a general idea of the facilities for, as well as the difficulties of doing the work, the next step is to locate tide gauges and tide observers.

Judging from all information that can be gathered of the prevailing winds, currents, tides, shoals, and the configuration of the shore line, the hydrographer will fix the number and sites of his tide gauges so as to get data for determining the figure of the surface of the water at any given instant. They should be more numerous the more the surface of the water at any instant deviates from the horizontal form. And the fewer the gauges used the greater the care to be exercised in deciding upon their locations. Placing a gauge within a bar, sand-bank or other impediment to the free action of the water, or within a lagoon which winds fill with water faster than it can escape, is to be especially guarded against. And in comparatively limited basins of water

it least two gauges should be established—one at that side of the basin nearest "whence the prevailing winds come," and the other nearest "whither hey go." These gauges are not only checks on each other when the wind's ction is an insignificant element, but where the wind drives water from one portion of the basin and piles it up in another, they furnish data indispenable for harmonizing soundings taken on those and calmer days.

In such a basin, when but one gauge is used, the proper place for it, theoectically speaking, is the center of the basin. These considerations attended o, each gauge is firmly fixed in a well sheltered spot, so that its zero shall be elow low-water at neap, and its top above high-water at spring-tides. By roper circumspection for the site of each gauge, one will generally be found o answer for each station, but where the observation is made from shore two r more may at times become necessary—the observer following the tide from auge to gauge as it goes out and retreating over the same path as it comes n. The kinds of tide gauges are as various as the circumstances demanding hem. The one ordinarily used is of the simplest kind, a straight vertical ost divided into feet and tenths, numbered from the bottom upwards; this s found generally to serve its purpose, inasmuch as when it is too windy to ead the gauge correctly, it is blowing too much to sound accurately. A verical tube with small holes at the bottom to admit the water which supports a loat, is, however, susceptible of closer readings under all circumstances; and or getting off-shore tides, Mitchell's gauge is admirably adapted; while as a self-registering gauge, Saxton's stands without a parallel and leaves nothing o be desired.

The zero of each gauge should be referred by means of a spirit-level, or otherwise, to a bench mark cut distinctly and durably on some permanent object (and the remark made in the book), so that, if displaced, it can be roperly replaced in position.

For the purpose of reducing the soundings, it is mainly essential that the de-gauge and sounding-boat watches be together; but where the laws of the des of the locality are also desired, it is best to keep either lunar or mean lar time. A series of observations of the tides on these gauges, made simulneously with the soundings, furnish data for reducing each sounding to the ference plane—the mean of the lowest *low* waters. This plane is also given y these tidal observations. The frequency of the necessary readings of the uge varies from every half-hour to every five minutes, according to the pidity of the rise and fall of the tide.

And now, if there be not on the shore permanent well defined objects that ill serve as signals—such as spires, towers, flagstaffs, light-houses, or tall ender trees, fixed by triangulation—then the hydrographer erects the necesary signals; usually tripods boarded up, and painted white if projected on ark back-ground from the sounding-boat, or red (or black) if against the ky or a sandy back-ground.

The tide-gauges and signals being erected, the next step is to determine arefully with a theodolite the relative position of these signals, and plot em by the computed sides of the triangles of which they are the vertices. t is, however, not imperative that the actual sizes of the triangles be at first

known; but the triangles can be computed and plotted from any assumed base, since the "relative positions of the signals" is the essential desideratum.

Hydrographic surveys all have for their main object the tracing, determining, and plotting, on a suitable scale, the contour lines of navigable channels and water-basins. Contouring represents the inequalities of the earth's surface by determining the relative heights of any number of points above or below a line equidistant at every point from the earth's center. This line is what is understood by the term "a level-line," and is that which is assumed by the surface of the water when at rest. In mapping the contours of parts of the earth not covered with water, after the principal contour lines are drawn on the topographical sheet, intermediate lines may, with the ground before the eye, be sketched in; but such interpolations are obviously impossible when tracing the contour lines of a basin filled with water, as in hydrography, where a series of points in the curves of equal depths are brought out only by lines of levels made with the sounding-line. Now, since these lines of equal depths are analogous to contour lines on land—being contour-lines of the bottom of the water-basin, drawn through those points where the reduced soundings are equal—the same rule hence obtains in hydrography as in topography for the directions of the lines of levels for developing them—viz., perpendicular and parallel to the strike or dip of the bottom, i. e., one system of sounding-lines coincident with, and another at right angles to the lines of the steepest declivity of the bottom. The lines run in the general directions of the curves of equal depths, or horizontal curves, are the main lines in developing the contours of the bottom; yet the auxiliary lines which should be run perpendicular to these not only check these depths, but also furnish additional data for drawing these curves of equal depths. At a crossing of these lines the difference of the soundings should not be more than three per cent., and the limit of error must not exceed five per cent. of the depth.

To form some idea of the general configuration of the bottom of a body of water, we must call in every available aid; as, the topography and geology of the adjacent coast, the effects of currents, tides, and prevailing winds, and, most of all, the revelations of our lead-line, which assist us in judging of the topography of the parts yet unsounded, and hence better fix upon the directions of the lines to be run. The force and directions of winds and currents and qualities of the vessel must of course be considered in laying out directions of sounding-lines. And the greater discretion exercised in giving directions to these lines the fewer in number will it require to bring out the bottom's varied features in the length and breadth of their modulation. The number of lines required depends upon the extent of the information to be furnished by the chart.

If for purposes of general navigation, the soundings on the map will be sufficiently numerous when the horizontal curves (viz., fathom and half fathom, up to three fathoms, and inside of that, feet curves) can be drawn without doubt as to their directions in any case. As to the frequency of the casts, where the bottom is very irregular, are wanted not casts at studiedly regular intervals, but every possible sounding.

Whether it is the demands of the navigator or the marine engineer that are being satisfied, along with these contour lines of the bottom are required the materials of which the bottom consists, the level, rise and fall of the water, the directions and speeds of its currents, and at times, the temperatures and specific gravities of the water. The accuracy of the methods and instruments for executing these surveys also varies with the amount of detailed information required. If the survey be made for the erection of a breakwater, instead of purposes of general navigation, then are desired nicer instruments for observations, more well-determined signals, more cast positions determined, more soundings on a line and more lines of soundings, more specimens of bottom and more current observations. In every case, however, the whole ground should be gone over thoroughly to bring out the general features of the bottom and detect each sudden irregularity of depth, which should be traced through its every line of approach, and if it proves to be an isolated knoll or ridge, it may be "rayed off" by planting one or more temporary buoys on it, and to and from them running radii in different directions. However, as these radial lines are often insufficient to bring out its every feature, others may be run at right angles to them. Yet for general purposes of navigation the general features and extent of a reef and the shoalest cast on it are found amply sufficient. As each sounding is taken, the surveyor notes its depth and also the time which fixes its position with reference to other points on the line determined by either sextant, theodolite or compass angles on known fixed points.

The degree of precision with which the positions of the sounding-boat are fixed determines the accuracy, and hence usefulness, of a hydrographic survey. To fix the position of the sounding-boat, under every variety of circumstances, is, therefore, the all-important problem in practical hydrography, and the method most universally relied upon by the hydrographer for determining his boat's position, is that by the three-point problem.

This problem is wide in its application, accurate in its determinations, and most simple in its graphic solutions. The simultaneous observation of the two angles subtended by three signals fix the place of observation under every possible contingency—except when it is on the circle passing through these three signals—i. e., when the three circles of position are coincident. The accuracy of the determination of positions by this problem depends mainly upon the relative positions of the signals and the observer, and the size of the observed angles—being the very best where the signals are equidistant from the observer, and subtending angles of 120 degrees. The three signals in a straight line, is a favorite location with many hydrographers, as it offers but one case of indetermination, and that very easily avoided, of being on the straight line passing through them. But in general a most desirable location is where the circle through the three signals is convex towards the observer, and the middle one is the nearest of the signals, for then "a revolver" is impossible. Other things being equal, it is better to "angle on" the more distant objects which subtend good-sized angles—say from 45 to 135 degrees—for not only is the parallax of the sextant then less, but an error

made in getting an exact coincidence of the images of the signals is then less felt by the angles than if the signals were near or the angles very acute.

And besides what is thus told by the relative positions of the signals, the hydrographer should be able to read the tale which the size of the observed angles tell of a position's fixedness. If the sum of the observed angles equals 180 degrees or more, then the observer is sure he is not on the circle of indetermination. But if this sum is less than 180 degrees, and equal, or nearly so, to the supplement of the angle subtended at the middle signal by the other two, then the position is not determined. By having these supplements written about the signals, between the proper lines, on the field-sheet, we can by a mental summing of the observed angles tell (without plotting) whether we are too near the circle to get a good determination; and may thus catch other angles that better fix our position.

The three-point problem finds in the three-arm circular protractor an accurate, simple and most expeditious graphic solution, which is most extensively used in plotting positions of the sounding-boat. In practice the observed angles are set off on the proper lines of the protractor, and the fiducial edges of its arms caused to traverse the three points representing the signals observed upon, and the center dotted, and the position is plotted. If breakers denoting danger be observed at a time when it is impossible to anchor over them, or even approach them to fix a buoy to mark their locality, their position may be marked quite accurately by pulling around them and getting cross ranges (or cross magnetic bearings) of prominent objects on shore, so disposed as to guide the observer to the spot in more favorable weather, when a perfect calm may leave no trace whereby the danger can be recognized.

Henry Edwards submitted the following:

Pacific Coast Lepidoptera, No. 11.—List of the Sphingidæ of California and Adjacent Districts, with Descriptions of New Species.

BY HENRY EDWARDS.

As the value of local lists is fully recognized by entomologists, I propose, in the present paper, to furnish a complete catalogue of the species of this interesting group of Lepidoptera, as far as known to me to inhabit the Pacific Coast, and to offer descriptions of what appear to me to be forms as yet unrecognized by science. The number of species, compared with those of the Eastern States, is but small, but extended exploration of our little known mountains and valleys may furnish us with others, while it is more than probable that many of those from Northern Mexico may yet be found within our borders; and, acting upon this belief, I have introduced the description of an exquisite species from the region of the Sierra Madre, which may some day have to be included in our lists. I have followed the arrangement proposed by Messrs. Grote and Robinson in their catalogue of Lepidoptera, (No. 1, Am. Entom. Soc., 1868,) and have invariably adopted the generic

terms of those authors. The notices of the habits and localities of the species are from my own observation, and for them I am personally responsible.

Tribe MACROGLOSSINI.

Arctonotus lucidus. Bdv.

Head, palpi, antennæ, thorax, and abdomen, yellowish olive. Thorax, with the tegulæ a little darker, and edged narrowly with white. Abdomen, with small anal tuft. Anterior wings, yellowish olive, with a darker median band, not reaching the interior margin, and surrounded by an oblique rich purple border along the interior margin, and obsolete before reaching the costa. This border has a rather brilliant metallic reflection. Beyond the middle is a notched shade of olive, resting on the costa, a small linear patch near the apex, and a lunate streak near the interior angle, of the same color. Fringe of the exterior margin, yellowish, with the edges brown; that of the internal margin, purplish, concolorous with the oblique band. Posterior wings, reddish fawn color at the base, with a rich claret-red submarginal band, narrowing inwardly, and lost in the brown hairs of the anal angle. Margin, broadly reddish fawn color, the same shade as the base of the wings. Under side, grayish olive, with a ferruginous patch on disc of the anterior wings. Fringes, deep fawn color. Middle tibiæ, with four black, shining, palmated spines, recalling somewhat the structure of the fore tarsi of *Gryllotalpa*. Hind pair, with two spines, fawn color, clothed with hair.

Expanse of wings, 2.00 inch.

Length of body, 1.00 inch.

Coll. Dr. Behr, Sacramento. H. E., Oregon.

I have taken the liberty to redescribe this very rare Sphinx, as Dr. Boisduval's description is both brief and vague, and as I have had the good fortune, recently, to examine six specimens of this little known insect, which were forwarded to me from the Dalles, Oregon, for the most part in excellent condition. At present, this is certainly one of the rarest species known to American entomologists. I have followed Mr. Grote in placing this genus in the present group, though not without misgivings, as its general structure, particularly the form of its antennæ, its long body clothing, and its extremely short tongue, seem, as Clemens observes, to point out its proximity to the *Bombycidæ*. It has been placed by this author, and by Walker, at the extreme end of the *Sphingidæ*.

Hemaris Thetis. Bdv.

Through the kindness of my friend, Mr. Grote, I have recently had the opportunity of examining Boisduval's type specimens of this species, the former gentleman's admirable description (Trans. Am. Ent. Soc., Vol. 1, 1868) rendering further notice of it unnecessary. I should, however, observe, that in fresh specimens there is always present on the hind tibiæ a bunch of long, pale yellow hairs, which are not visible in the somewhat worn and faded type specimens. The presence of the reddish apical spot in the anterior wings is, I think, by no means a safe character, as in any one of my specimens it is

quite apparent, while in two others it is entirely absent. This species may, however, be always known by the thoracic and abdominal clothing, which is invariably dull olivaceous, with a brownish tinge, and is extended without any break to the yellow pre-anal segments. *H. Thetis* is found in the valleys of California, chiefly in the neighborhood of the Coast Range, and may be sought for, in May and June, in Napa, Sonoma, and Marin Counties. It is especially attached to the flowers of various species of *Lupinus*.

Coll. H. E., (exactly agreeing with Boisduval's type) Dr. Behr, *et al.*

Hemaris rubens, n. sp. (?) Hy. Edw.

Under this name, if a true species, I wish to recognize two specimens, in my collection, in which the apical red mark is very distinct above and below, the oblique scale patch at the base of the primaries reddish, and the costa and margins of the wings on the lower side also with a decided reddish hue. In *H. Thetis*, the two pre-anal segments alone are yellowish, but in the two specimens referred to above, the yellow is carried on to the third segment, dorsally and beneath, but is interrupted on the sides by a black band. This appears to me to be a strong character, as in my examples of *Thetis* the yellow shade is distinctly confined to the two pre-anal segments. Slightly smaller than *Thetis*. The tuft of yellow hairs on the hind tibiæ is present in this species.

Oregon, Lord Walsingham. Lake Tahoe, Cal., Mrs. Hy. Edwards. Coll. H. E.

Hemaris cynoglossum, n. sp. Hy. Edw.

Size of *H. Thetis*. Head above, pale yellowish olive; eyes, margined behind with white scales. Palpi, pale yellowish, with the terminal joint tipped with black. Thorax above, bright greenish olive, without the brown tint observable in *Thetis*. Basal segments of abdomen, rich velvety black. Two pre-anal segments, pale yellowish, with a darker median shade. The under side of abdomen, including the anal tuft, is wholly black, except the edges of the pre-anal segments, which are pale lemon yellow. The thorax is less covered beneath with yellowish hairs than in *Thetis*, and the pale scales are hardly visible at the base of the wings, while the tufts of yellow hairs on the tibiæ, so eminently characteristic of *Thetis*, are here wholly wanting. The wings above and below are similar to the allied species, but are decidedly more opalescent, giving out a most beautiful bluish reflection. Antennæ, blue black. The fore wings are a little sharper at the apex than those of *Thetis*.

Two ♂, two ♀, Coll. Hy. Edw., taken by myself on flowers of *Cynoglossum grande*, Dougl.; Napa County; Big Trees, Calaveras County, Cal.; Vancouver Island.

The species of the genus *Hemaris* are very closely allied, and can be separated only by characters which in other genera would hardly be deemed sufficient to indicate a difference of species. I think, however, that the absence of colored hairs on the basal segments of the abdomen, and of the pencils of yellow hairs on the hind tibiæ, will serve as good grounds for

separating this form from its allies. The differences between them are very apparent in a series of each.

Hemaris palpalis. Grote.

Taken at Gilroy, Santa Clara County, by the late G. R. Crotch. Its chief difference from *Thetis* seems to be in the darker shade of the labial palpi.

It is somewhat remarkable that no species of Mr. Grote's genus *Hæmorrhagia* has yet been discovered on the Pacific Coast, more especially as in the Atlantic States the species are more numerous than those of *Hemaris.*

Ællopos tantalus. Hubner.

This fine insect is not rare in the neighborhood of Mazatlan and other portions of Northern Mexico, and I have seen a specimen taken at Cape St. Lucas, Lower California. It may, therefore, yet be found within our limits.

Euproserpinus Phaeton. G. & R.
=*Macroglossa Erato.* Bois.

This exquisite little species, so rare at present in collections, appears to be found only in the vicinity of Los Angeles, two specimens in the collection of Dr. Behr and the original types in that of Dr. Boisduval having been obtained from that locality. It is said to be an early insect, and probably disappears with the flowers of the spring.

Proserpinus Clarkiæ. Bois.

As the delicate green tint of this beautiful insect fades very quickly, I subjoin the following description from a very fresh specimen, taken during the past summer, in which the original color is at present admirably preserved. It will be seen that both Clemens' and Boisduval's descriptions give a wrong idea of the color of the insect.

Head, greenish olive above, whitish beneath; labial palpi, whitish, with green tinge. Eyes and tongue, brownish black. Antennæ, black above, reddish beneath; terminal spinule, white, with the extreme hook yellowish brown. Thorax above, greenish olive, whiter at the sides and beneath. Abdomen, greenish olive with a white tinge, except the three anal and the fifth segments, which are dark olive green, the anal segment being marked in the center with a paler streak. Beneath, the abdomen is greenish olive, with the segments edged posteriorly with white. Anterior wings, rich greenish olive, the color of *P. Ænotheræ*, paler at their base, except towards the costa, where there is a darker shade. "The median space is rich greenish olive, narrowing to the internal margin, and enclosing a black discal streak." Behind this band, and resting on the internal margin, is a pinkish shade, not visible in old specimens, and beyond this is a rich olivaceous band, spreading to and widening out upon the costa, the outer edge being somewhat notched. Fringe of the anterior wings, olive green, tipped with black Posterior wings, bright orange yellow, with a broad and moderately regular black marginal band. Fringes, yellowish white. Under side of wings, wholly olivaceous green, darkest at the base. Across the disc of the posteriors is a slightly waved

whitish band. The discal streak of the anteriors is scarcely visible. Feet and legs, whitish green.

Not rare in the northern portion of California and southern Oregon. A number of specimens were taken by Lord Walsingham, near Fort Klamath, and it occurs not unfrequently, in May and June, throughout the Coast Range and the Sierra Nevada. It appears to delight in the flowers of the various species of *Gilia*. Dr. Boisduval says that his specimen was raised from the caterpillar by the late Mr. Lorquin. It is a matter of regret that we possess no record of its earlier stages.

This is undoubtedly the species referred to by Mr. Grote in Bull. Buffalo N. H. Soc., 1874, as *Lepisesia Victoriæ*, the description having been evidently drawn up from a somewhat faded specimen.

Proserpinus Terlooii, n. sp. Hy. Edwards.

Head and palpi, yellowish olive. Eyes, black. Antennæ, dark olive; pectinations, brown; hooked tip, white. Thorax and abdomen, yellowish olive, the former with some darker shading in front. Anterior wings, yellow olive, greener towards their outer margins, with a median band of olive green, widest on the costa, and a triangular patch, a little paler than the band, resting on the costa near the apex. Fringe, mottled with brown. Posterior wings, dull claret red, paler along the costa, and shading into deep rich brown on the posterior margin.

Under side. Anterior wings, yellow olive, with a wide central shade of dull red, reaching from the base to within three lines of the margin, but not touching the costa. Posterior wings, yellow olive, with indistinct waved median band of a little darker color.

Expanse of wings, 1.65 inch.

Length of body, 0.70 inch.

Two ♂ Coll. Dr. Behr, taken near Mazatlan, Mexico, by the late Baron Terloo, to whom, at Dr. Behr's request, I dedicate this interesting species.

Tribe CHÆROCAMPINI.

Chærocampa procne. Clemens.

I can learn nothing whatever of this insect, and think some error must have occurred as to its locality. Is it known that the type specimen is in existence, and, if so, where?

Deilephila chamænerii. Harris.

This species, which I am disposed to regard as different from *Galii* of Europe, is not uncommon in Vancouver Island, and has been occasionally taken in Oregon and Northern California. It would satisfy many entomologists if a long series of this insect could be raised from the caterpillar, through a succession of years, as by these means alone can we arrive at a certain conclusion as to its value as a species. It seems to me to be a much heavier and more clumsy-looking insect than *Galii*, and its general color is considerably

darker. But it appears somewhat absurd to claim for this the rank of a species, and deny the same position to its congener, which follows, as between *Daucus* and *Livornica* more really serious differences exist than between *Chamœnerii* and *Galii.*

Deilephila Daucus. Cramer.

This is perhaps the most common of all the *Sphingidœ* of the Pacific Coast, being found from May to August in almost every garden, hovering about flowers, especially those of *Verbena.* The caterpillar, though well known, has never, to my belief, been described or figured. It feeds on various species of *Rumex, Epilobium* and *Polygonum.* The additional white stripes upon the thorax certainly give this a wide separation from *Livornica* of Europe, while there is considerable difference in the shape of the median oblique band of the anterior wings. In a specimen of *Livornica* from Italy, and also in one from the White Nile (both in my collection), this line is broader than in the American specimens, and, as it reaches the internal margin, spreads inwardly further towards the base of the wing. The costal markings also are more decided in the European and African specimens, and the marginal band of the posterior wings is certainly much narrower.

Philampelus Linnei. G. & R.

A fine specimen of this very handsome species exists in Dr. Behr's collection. It was taken by the late Baron Terloo in the northern part of Sonora, Mexico, at the base of the Sierra Madre.

Philampelus Achemon. Harris.

Very common, in some seasons, in the valleys of Napa and Sonoma Counties, where the caterpillar is exceedingly injurious to the vines. In the summer of 1874, at St. Helena, Napa County, over ten bushels of caterpillars were gathered from one vineyard, only four acres in extent, in the course of two days. I can perceive no difference whatever between the California specimens and those from the Eastern States.

Tribe SMERINTHINI.

Smerinthus ophthalmicus. Bdv.

Formerly rather common in the vicinity of San Francisco, but owing to the drainage of large districts, and the consequent destruction of the willows on which the caterpillars fed, it has become quite a rare species. In the foothills of the Sierras and the Coast Range, as well as in Oregon and Vancouver Island, it is occasionally met with, and a strongly marked variety is also found, which I have called

Smerinthus pallidulus, var. Hy. Edw.

It differs from the typical form by its much paler color, as well as by the almost obsolete markings of the upper wings. The general color of these is a

pale fawn drab, with the waved band indistinct. The thorax is also much paler, and the median patch of this portion much narrower and less defined.

Mr. Strecker's figure of the ♀ in Lepid. Rhop. et Heter. refers to this variety.

Smerinthus modestus. Harris.

Another very remarkable instance of departure from the specific type is found in our examples of this species, all of which are very large in size, the smallest I have seen being upwards of five inches in the expanse of wing, the specimens from the Atlantic States rarely measuring as much as four inches. There is also a remarkable difference in color, the western specimens being much paler, the basal space within the median band being, for the most part, of a delicate silver gray, which color is also extended to the thorax and abdomen. The white discal streak is also more strongly defined, and the suffused reddish patch of the lower wings usually much larger. Knowing nothing of the caterpillar, I am unable to say if any difference exists between it and its eastern relative, but it is possible that in this instance we have to deal with a new species. I prefer, however, at present to regard it only as a variety, suggesting for it the name of

Smerinthus occidentalis, var. Hy. Edw.

Fort Yuma, Ariz. San Diego. Sacramento, Cal. Carson City, Nevada. Dalles, Oregon.

Coll. H. E.

Tribe SPHINGINI.

Macrosila carolina. Clem.

As far as I am able to discover, this species was unknown in California until the introduction of tobacco planting, a few years ago. It is now very common in some portions of the State, particularly in the San Joaquin and Santa Clara valleys, and promises to be as great a pest to the growers of tobacco as it has proved in other parts of the continent.

Macrosila celeus. Hbn.

Rather rare at present, though it has been taken near San Diego, and in Mendocino and Napa counties. The caterpillar feeds upon the potato, and it is probable that, like the preceding species, this may be an introduction from the Atlantic coast.

Macrosila cingulata. Fab.

I have seen only two Pacific coast specimens of this insect, one from San Diego, the other from Santa Barbara. It is very abundant in the Hawaiian Islands, where the caterpillar feeds on the sweet potato (*Batatas edulis*).

Sphinx oreodaphne. Hy. Edw. (Proc. Cal. Acad. Sci., July, 1873.)

My friend Mr. H. Strecker, of Reading, Pa., has suggested to me that this may be only a small form of *Sph. chersis*, Hbn., and certainly there is a great resemblance, excepting in point of size, the largest specimen of *Oreodaphne* I have seen measuring only 3⅛ inches in expanse, the smallest 2¾ inches, while the average size of *Chersis* is 4⅛ inches. The markings, also, even in the most perfect specimens, are much less pronounced than those of *Chersis*, and the general color of the insect is much paler. If, however, Mr. Strecker's conjecture be correct, the synonymy will have to be
Sphinx chersis. Hbn.

Var. *Oreodaphne.* Hy. Edw.

Sphinx perelegans. Hy. Edw. (Proc. Cal. Acad. Sci., July, 1873.)

I am inclined to think that this and the following species are only two of others which will yet be found in California, having an affinity with *Sp. gordius* and *Sp. eremitus* of the Atlantic States. The only specimen of this species was taken by the late G. R. Crotch, at Gilroy, Santa Clara county, and is in my collection.

Sphinx Vancouverensis. Hy. Edw. (Proc. Cal. Acad. Sci., July, 1873.)

Since describing this species, I have had the good fortune to procure two other specimens, one from Portland, Oregon, and the other from the Big Trees of Calaveras county. They are so strongly marked as to put to flight any doubts I may have entertained as to the genuineness of the species.

Hyloicus Sequoiæ. Bdv.

I am only acquainted with one specimen of this very rare species, taken by myself in Bear Valley, Placer county, and noticed in Proc. Cal. Acad. Sci., July, 1873.

Hyloicus Strobi. Bdv.

Dr. Boisduval is himself in doubt as to the locality of this species, and without a careful examination of the type it is difficult to say whether it be Californian or not.

LIST OF SPECIES NOTICED IN THIS PAPER.

Arctonotus lucidus, Bdv. . . . . California, Oregon.
Hemaris Thetis, Bdv . . . . California.
Hemaris rubens, Hy. Edw. n. sp . . . . California, Oregon.
Hemaris cynoglossum, Hy. Edw. n. sp. . . . . California, Vancouver Island.
Hemaris palpalis, Grote . . . . California.
Ællopos tantalus, Hubn . . . . Mazatlan, Mex.
Euproserpinus Phæton, G. & R. . . . . Los Angeles, Cal.
Proserpinus Clarkiæ, Bdv . . . . California, Oregon, Vancouver Island.

Proserpinus Terlooii, Hy. Edw. n. sp........................Mazatlan, Mex.
Chœrocampa procne, Clem. . ...Loc. dub.
Deilephila chamœnerii, Harris.........California, Oregon, Vancouver Island.
Deilephila daucus, Cram......... Arizona, California, Nevada, Oregon, V. I.
Philampelus Linnei, G. & R................................Mazatlan, Mex.
Philampelus Achemon, Harris..........................California, Oregon.
Smerinthus ophthalmicus, Bdv.........California, Oregon, Vancouver Island.
Smerinthus ophthalmicus, n. var. *pallidulus*, Hy. Edw .... California.
Smerinthus occidentalis, n. sp. (?), Hy. Edw.. Cal., Nevada, Oregon, Arizona.
Macrosila carolina, Clem.............................California generally.
Macrosila celeus, Hbn...California.
Macrosila cingulata, Fab................. San Diego and Santa Barbara, Cal.
Sphinx oreodaphne, Hy. Edw.... ....California, Oregon.
Sphinx perelegans, Hy. Edw...................................Gilroy, Cal.
Sphinx Vancouverensis, Hy. Edw......California, Oregon, Vancouver Island.
Hyloicus Sequoiæ, Bdv.... . ...Sierra Nevada, Cal.
Hyloicus Strobi, Bdv.................. ....Loc. dub.

Col. Geo. E. Gray offered the following resolutions, which were adopted:

WHEREAS, The California Academy of Sciences has learned of the resignation of Professor Daniel C. Gilman of the Presidency of the University of California, and of his contemplated removal to Maryland; and

WHEREAS, The important services rendered by Professor Gilman, to the University and the cause of higher education, in California, are known and appreciated by this Academy. Therefore, be it

Resolved, That the California Academy of Sciences expresses to Professor Gilman its appreciation and approval of the work he has here accomplished, its confidence in his ability, and its testimony to the energy and devotion which he has exhibited in the performance of his duties as President of the University of California; that we thank him for the services he has rendered to the cause of higher education, here and elsewhere; that we regard his removal, so far as it affects this community, with regret, tempered by the conviction that in the new field of labor upon which he is about to enter, his varied acquirements, combined with many fortunate personal qualities, will prove fruitful in benefits to the entire country; that he will carry with him our respect as a fellow-worker, and our esteem as a fellow-member and a man.

Resolved, That the Secretary is hereby instructed to transmit a copy of the foregoing to Professor Gilman, and to the Trustees of the Johns Hopkins University at Baltimore.

REGULAR MEETING, MAY 2, 1875.

President and Vice-Presidents being absent, Dr. H. W. Harkness was called to the Chair.

Sixty-two members present.

Charles Wolcott Brooks read the following paper:

Origin and Exclusive Development of the Chinese Race —Inquiry into the Evidence of their American Origin, suggesting a great Antiquity of the Human Races on the American Continent.

BY CHARLES WOLCOTT BROOKS.

In searching for the origin of any race, the careful student is led to the barrier of pre-historic ages, where, amid the scanty remnants of remote antiquity, he seeks the missing links of a chain whose farther end has passed from the vision of general observers.

All ethnologists must recognize the importance of reviewing the early stages of religious belief current among any people, and laws governing its development, in any systematic study of their earliest origin.

Every act of man and every change in nature is self-recording, and although it may require the wisdom of a God to read the record, it yet exists, capable of being deciphered, and contributing to history.

With the advance of scientific knowledge, the human line of division between so-called historic and pre-historic ages is gradually receding. Science and historical criticism are opening many fields long hid in myth and conjecture. Much now classed as ancient mythology is but the lingering remnants of very ancient history, preserved and distorted by tradition. Most ancient nations in their written histories, have aimed as far as possible to ignore all antecedent civilizations, claiming for their own deified ancestry the origin of all men. Barbaric conquerors, filled with the spirit of battle, were early deified as gods, their descendants accepted as demi-gods were founders of reigning dynasties, and naturally sought protection by surrounding their origin with the supernatural. Transformations are frequent in the mythology of all nations, for religion, in whatever stage of its development, ever remains a grand, progressive, moral science. Many ancient forms of pagan worship glided silently into even Christian rites, when martyrs canonized as saints, noiselessly replaced the divinities of former systems.

As most early gods were ancient heroes deified, their worship was a nat-

ural manifestation of a low order of patriotism, which selfishly detested all nations but one chosen people. Each nation seems to have created its own god in the image of its highest ideal. Early ideas of God have been successively adjusted to the intellectual capacity of each progressive age, whose highest ideal has ever been the natural limit to its powers of mental or spiritual conception, possible under existing conditions of development.

Modern science and its civilizing arts have refined our personal conceptions and raised our ideal, by extending our limits of comprehension. Our own conceptions of the Great Architect, the Intelligent Mind of the Universe, as they exist to-day, are as much nobler than those of the ancients, as the magnificent enginery of this nineteeenth century excels the rude implements of early ages.

Notwithstanding this tendency to ignore antecedent civilizations, the most ancient peoples of antiquity, at the period of their very earliest records, show plainly that civilized life existed before their time.

In speaking of civilization at early periods, it is evident we cannot mean that of the printing press, telegraph and steam, as known in the nineteenth century, for no record of any such exists, but reference is made to a high state of early culture among cities of solid structure, with foreign commerce and mechanic arts, in contradistinction to barbaric, nomadic, or pastoral conditions.

Great maritime empires existed in very remote periods; and both Alantic and Pacific Oceans were crossed, and races and civilization widely extended in ages still called pre-historic. Whether we study the historical records of Arabian, Phœnician, Chaldean, Assyrian, Egyptian, Persian, Central Asian, Malay, Chinese, Japanese, Central American or Peruvian nations, we are amazed at the antiquity to which they lead us. Many oriental records now in process of translation, throw much light on the early movements of races. Asia in the far East was long considered the land of enchantment—a name given by superstition to early science. Astronomy was cultivated in Persia B. C. 3209; in India, B. C. 3101; in China, B. C. 2952; and in Egypt, B. C. 2800. Truly, wise men came from far east of Greece and Rome.

In Egypt, India, China, America and South Pacific Islands, evidences of a primitive civilization are found, which, in some instances, must have run its course long anterior to the age of Homer. Unmistakable traces of a primeval and ante-historic culture of the human race in America exist to mark the lapse of many ages of civilized existence. A knowledge of the western shores of the American continent has long existence in both China and Japan. That a restricted communication has existed by sea across the Pacific does not admit of question. When treating of the origin of the Japanese races several historical instances of their early trans-Pacific voyages will be described and discussed.

In comparatively modern times, enthusiastic specialists, versed in Hebrew traditions, have sought to locate the primeval source of all knowledge and culture upon the high table lands of Asia, where they pictured the radiant morning of civilization as immediately succeeding the completion of a cre-

ated world, perfected in all its parts, including man, the most complex being and climax of creation.

In a search after the origin of any race, we are first led to define a belief in the origin of man. I accept the hypothesis of universal evolution by a slow process of cosmic development, from matter which includes within itself the elements of all atmospheric, mineral, vegetable and animal existence, but latent until its energies are quickened by that progressive life-principle which ceaselessly radiates from the Great Intelligent Mind of the Universe, and is everywhere essential to awaken development.

This hypothesis, clearly within the scope of human thought, is able to stand the test of human reason, and now seems tangibly demonstrated, especially in the connected chain of fossils recently discovered and arranged by Professor Marsh, which visibly illustrate, by an incontrovertible record of natural history, the evolution of the *eques* or horse family, anchitherium, hipparion, etc.

All material things appear connected together by gradational forms, from the superior mental culture of man, the highest animal, to the protozean or lowest speck of gelatinous matter in which life manifests itself to human perception, onward through untold ages of mineral existence and cosmic conditions, ever in exact keeping with its pace of progress. All things that develop have life. Earth has labored to fit itself for the abode of man, and its labors are progressing successfully. Man came by regular stages of gradation from the monad, and his mental development keeps pace with and is restrained by physical surroundings. Immutable natural laws, universally and eternally in force, do not admit of any sudden, special creation of man, nor do they indicate that all forms of animal life could have been created at the same time. What has once occurred will, under similar conditions, occur elsewhere.

Man is the result of all inferior types, whose capabilities are within himself, making him a compendium of all created things. Fossil remains, found in different formations, are plainly revealing the stages of progressive transformation, each successive one having all the attributes of its predecessor, with more added. Crustaceous animals are succeeded by fishes, running into the saurian, thence into birds, next marsupials, followed by the mammalial, up to man. Animal development has unfolded, and is continually improving as the physical conditions of the globe are improved and refined, and higher conditions rendered possible.

Mind is an attribute of matter, each being instrumental and necessary to develop the other. Goethe says: "Mind cannot exist without matter, nor active matter without mind."

The man of cultivated mind has reached more than a mere physical being, having developed within himself a portion of that superior intelligence, the germ of which he inherits from the Mind of the Universe. The human mind is unmistakably progressive, and progression is an eternal principle. Hence, mind, the highest refinement of matter in man, is eternal. Our greatest revelation from the Infinite is in His works, where nature matures a supply for every want she creates. The power to conceive of immortality

therefore implies ability to attain it. This glorious truth is instinctively felt and recognized by every branch of the human race.

The origin of man has been gradually, yet hastily, traced as the result of a constantly progressive life-principle, awakening development in matter, successively evolving from cosmic conditions, minerals, plants, and all the lower forms of animal life, up to its climax, intelligent humanity. In man is to be found the highest physical ultimate of matter, endowed with that further refinement, a moral and progressive spirit, capable of ultimately unfolding his full physical and mental capacities. In human evolution, we can but outline the origin of existing physical forms, which periodically change with constantly modifying conditions. The immortal quickening principle which we inherit, can only be traced to the Infinite.

The animating principle of all existences, appears like a purer and more highly refined essence or form of electric force; equally manifest in mental and physical development, and exactly adjusted in all its different degrees to successive stages of progressive refinement. Natural law is universal. In the material process of electrotyping, man follows Nature's own method of building up metallic forms. The progressive life-principle of the human mind, in common with endless varieties of electric phenomena, manifests universal consistency in the positive and negative phases of a subtle activity. Some correlation with a Central Intelligence seems reasonably indicated, whence these mutually radiate as developing powers; alike in kind, varying only in degree, of force, purity and refinement.

It appears probable that the ancestors of the earlier types of mankind, were evolved, by gradual development, near the oldest parts of continents, along their central summits, upon such portions as first acquired a soil after emerging from a hot primeval sea. Primitive man, at first a speechless animal, may have appeared as a distinct variety of the animal kingdom, in the case of a single pair, from which all human races have multiplied, and differentiated according to the surrounding conditions of their local abode. If so, the physical conditions of certain localities have been far more favorable to the advancement of certain races than others, and early human history must be by *race* and not by *nations*, as communities of individuals come but with the first steps to culture.

Within the limits of races best known, languages and families of languages are found, which preclude any common linguistic origin. It therefore follows, that if man constitutes but a single family in the order of Primates, represented by a single *genus*, the formation of language must have commenced after the still speechless primordial man had diverged into races, and differentiation had set in. With the development of ideas in the mind, however rude at first, and organs capable of articulation in the body, language was a consequent result, under the operation of universal law. The Great Intelligent Principle of the Universe pervades the entire world, as our mind fills our whole physical frame. The manifestation of this principle we call Life, which all things possess in greater or less degree.

Development is ever progressive, although mutability appears to mark every advance, yet no breach of continuity has occurred. Every order has proceeded by natural process from another antecedent. The superimposed

strata which constitute the crust of the earth, form a gauge of relative time, for which human chronology scarcely affords a unit of measure. It is perfectly certain that during the cretaceous epoch, a comparatively recent period in the world's history, none of the physical features existed, which mark the the present surface of the globe. Continents have undergone movements of elevation and depression, their shore lines sunk under the ocean, and sea-beaches have been transferred far into the interior of pre-existing continents. All dry land has been submerged, excepting recent volcanic products and metamorphosed rocks. These introductory facts are necessary to ethnological research.

A cooling sphere, having acquired a solid crust around a nucleus of fiery liquid, in parting with its heat by radiation into space, must contract, distorting its outward surface by pressure, raising mountain ridges, and depressing corresponding valleys, where the first seas became located. Sun and moon, obedient to the law that bodies move to each other in proportion to their masses, and inversely as the squares of their distances, attracted tidal movements in molten fluids under the crust, in hot salt seas, and the thick unrefined atmosphere above. Fluids as well as other matter were more gross during their primitive states. Rupture and re-formation succeeded one another, until the primitive igneous period of angular azoic granite, became sufficiently hardened to withstand the ordinary pressure of inward forces, gradually preparing to furnish physical conditions, suitable to begin the evolution of animal life in its most elementary forms, corresponding with the imperfect condition of existing elements.

During the mighty struggles of the unrefined elements, internal convulsions sent the hot salt sea surging over a large portion of the surface, and sedimentary deposits formed new stratifications. Substances impregnating the waters united in forming crystals. The waters, having raged from point to point, were obliged to seek an equilibrium, and retired to the valleys, forming various oceans, seas, lakes, and rivers.

In the early carboniferous period which succeeded, the extra nitrogen and carbon were rapidly absorbed from the air, and the density of all exterior elements greatly reduced. A period was thus established, where, under favorable auspices, and in limited localities, the very imperfect initiatorial orders of vegetable and animal life appeared. An infinity of embryo existences are contained within the crust of the earth, awaiting the slow process of development. Life generated at the initial period was of the very lowest order, unable to support or reproduce itself to any considerable extent. From this threshold of progression, conditions became sufficiently advanced to admit of the systematic reproduction of species; the age of spontaneous generation having performed its limited duty in the general ripening of the globe, may have ceased and passed away with conditions which sustained it, and matter, within itself, matured the power to reproduce its kind, endowed with a progressive principle, destined eventually to evolve its ultimates. This hypothesis explains why spontaneous generation may have had its day and subsequently ceased.

Crinoides, *conchiferæ*, *crustacea*, *polypi*, and *polyparia* successively appear as elements are advanced to the necessary conditions to sustain such forms of

life. The systematic development of *flora* and *fauna*, in successive ages, extends in an orderly chain from their dim and distant beginning, to our own time, through universal changes of atmosphere, climate, and oscillations of temperature. A continual unbroken chain of organisms has extended from palæozoic formations to those of our day, governed by law that knows no change. Each species has gradually evolved from its predecessor in an antecedent age, by a gradual modification of its parts, culminating in the age it characterizes, and fades away in succeeding ones.

Change is everywhere the soul of nature. The race which first acquired the human form, and became properly entitled to be called Man, probably ascended from one original type, which has since diversified, and may in this age be divided into five distinct *varieties* (not types), generally classified as Caucasians—*white*, Mongolians—*yellow*, Malayans—*brown*, Americans—*red*, and Negroes—*black*.

As white and black are apparent opposites, and science shows the white race to be superiorly developed, it is fair to presume that primitive man was black; subsequent nations, brown; their branches, red; from these sprang the yellow, and thence the white. Under local changes of atmospherical and physical conditions, of climate, food, etc., the original black became modified to a permanent brown. In like manner one shade and color after another became permanently established. As with complexion, so also with stature, symmetry, and strength. Proper use develops, while disuse brings decay.

Some anatomists have claimed that color may be produced by the arrest of utero-gestation, or is governed by its relative duration in races, thus "causing the ultimate portions of the blood to become so assimilated with the cellular and serous tissues of the fœtus as to render the body variously colored—black, brown, red, or copper color." *Lusus naturæ* have illustrated this fact.

The present of any race depends largely upon the physical conditions of the soil they inhabit. When these remain unaltered, the race cannot advance, unless it can develop, by brain power, sufficient ingenuity to overcome the drawbacks to advancement; such as draining marshes, heating dwellings, importing ice, etc., thus growing, in spite of natural restraint, faster than the slow process of natural evolutionary changes would permit.

Modifications in different types of vegetable or animal life neither progress equally nor evenly. There is no intrinsic necessity that they should undergo modifications at all, unless conditions change, or in the case of man, who invents ways of surmounting natural conditions. To him the extreme North becomes habitable by the use of warm clothing, artificial heat and light during long winter nights. By a restless spirit pressing him forward and a judicious control of elements, he is enabled to obtain artificial conditions far in advance of the physical condition of his habitation, and thus pre-naturally exalt and develop himself and his race. With the loss of these conditions the highly developed man would perish or relapse into a comparatively barbaric state, to where his development would exactly agree with his actual physical surroundings.

Darwin unmistakably illustrates the tendency of all forms to variations, which when once produced, join in equal battle to survive and supplant their

progenitors and all others. The fittest will maintain itself and the others perish, the parent and derived forms being equally dependent upon their individual adaptability to surrounding conditions. Thus, certain localities still exist in the condition of ages long past, where inferior races yet flourish and find themselves better off, more competent to deal with difficulties in their way, than any variation derived from their type. While conditions continue unchanged they remain unsupplanted by other forms, and their type becomes very pronounced. Exact reproductions are rare. Amid infinite similitude there is infinite diversity; and imperfection is a vast fact, which must always be taken into account in all hypotheses. "Animal beauty arises from the perfect balance of physical parts and the rhythm and perfection of their action." It is probable that no perceptible change has taken place in the Chinese race for many years, because in that time the incomplete changes of physical condition in their country have not admitted of it. Wheat found in tombs with Egyptian mummies, when brought from darkness into sunlight and planted in congenial soil, grew and produced wonderfully, but could never have developed without a change of conditions. Change is imperative to progress.

A complete knowledge of embryology furnishes an unerring record of the origin and development of any form of animal life; for the embryo of higher types, while in process of maturing, pass successively through a recapitulation of all forms by which their species ascended by evolution to their present condition. Since conception, each human being has passed rapidly through modifications, the counterpart of the graduated forms through which his race has been slowly built up, and his present condition reached. Thus, we have a history of human evolution republished in every case of reproduction.

Man, as traced by his embryotic development, commenced, when in darkness, the cohesion of two or more gelatinous molecules, impelled by a constantly-progressive life-principle, united to form a microscopic zoösperm, capable of preserving its new condition in a thick and heated liquid. The proportionate duration of early life in warm water is revealed by the first nine months of his existence, during which many successive but correlated forms are assumed. Dr. Cohnstein, of Berlin, (quoted in the *Lancet*, May, 1875,) "has determined by means of the thermometer that the temperature proper to the *fœtus in utero* is higher than that of the mother." The hot salt sea in which early life developed, is here typified. The period of atmospheric air having arrived at birth, emerging into light, his aquatic life ends, and becomes terrestrial and aërial. New elements of food are supplied, and the mode of nutrition changed. For awhile his food continues liquid, and he sees, hears, and notices but little. By degrees he arrives at a consciousness of the solid world, first rolling, then creeping, seal-like on four limbs, then sits upon his haunches, and finally walks erect, at first tremblingly, then playfully, but firmly, at last. This reveals how nature required successive physical conditions, to acquire progressive results. Each being owes his present bodily form, to ascent through a parentage, each change of which has passed away, after accomplishing its intended purpose, a culmination reached by degrees, through countless generations of improvement.

In due time, children acquire teeth, and another change of food ensues,

and hair usually darkens. A second set of incisor and carnivorous teeth soon mark another stage of progress, and youth succeeds childhood, bringing an expanded development of bodily form, passions, and intellectual power. No individual can reproduce until he reaches the full maturity of the type to which he at present belongs, which prevents the race from receding, by reproducing a lower type. Leaves grow out or drop off, but never grow back. Nature never retrogrades; advance or perish is law to the individual.

Man can imitate any animal of his species, but no animal can follow man beyond its developed powers. Many traits, exemplified in lower animals, are successively developed in children, and overcome by proper control; such as gluttony, cunning, and deceit—the latter a lingering trait of weakness, general with inferior races. They repeat the antics of a very active and mischievous race; their first attempts at drawing, resemble the rude figures made by our primeval ancestry and present wild tribes; furthermore, like "children of the forest," our younger children have not reached the age of self-cleanliness.

The impulsive ferocity of youth, and cooler maturity of age, are but characteristic types of human transformation in the evolutionary procession. Our lives acquire a double significance, when we find we are building an inheritance for every one of our descendants, while our race continues.

In our growth, we *re*-evolve, concisely, the story of our race's lineage, as in "*the house that Jack built*," each succeeding verse comprehends all its predecessors. Our present bodies now barely float; for, as man acquired his upright stature, his frame must have increased in weight and hardened into greater rigidity; while the pelvis, to sustain additional weight thus put upon it, enlarged, thickened and increased his gravity.

The head of the human species seems originally to have been large in proportion to the body, exhibiting a promising germ thus early advanced, a fact to which the race may owe its present superiority; and, possibly, this early development of the organ capable of acquiring knowledge, may account for peculiar sufferings, visited upon woman, more particularly among the most intellectually developed.

The highest type of man has been artificially advanced beyond the condition of some portions of the physical world. Miasmatic swamps are yet insufficiently reclaimed by time, to permit a white man's existence where they continue. Their present condition would involve his speedy illness and dissolution. Lower organizations, congenial to and in harmony with such conditions of physical development, may exist and flourish there; but more refined types of humanity, require the most perfected physical conditions, for their perfect enjoyment and highest attainments.

Centripetal law has consolidated the Chinese into a positive and exclusive people, who delight in ignoring the centrifugal or complimentary force, which induces dispersions. They have long clung to unique customs and dress, resisting change or improvement. In their stereotyped form of frozen civilization, differentiation has been arrested, and a peculiar type itensified. Unalterable fixedness in forms of belief, and habits concreted by centuries, furnishes convincing evidence of great antiquity. The black races are ethnologically far less developed, and having no fixed belief to displace, are more readily converted to any religious sect.

We cannot avoid admitting that the Chinese are one of the oldest families of the ancient world; yet they are by no means the oldest. Until the seventh century before the Christian era, they were perfect strangers to every form of idolatry. Pure Chinese appear like a race absolutely distinct from nations by whom they are surrounded, differing in physical characteristics of form, color, and expression; in language, in their written characters, their literature, and religious observances. Unchanged by foreign conquests, by extensive intermixture with any foreign race, they have developed within themselves, preserving and perhaps intensifying their type; governed and civilized by the principles contained in their own classic literature, and in their pure and excellent book, the Chou-king, compiled fully 3,000 years ago, from their more ancient literature, much as many suppose Moses to have compiled the Pentateuch, or as Heroditus compiled early Grecian history.

China has her ancient picture writings, but no ancient idols. She has her literature older than the Sanscrit races. When the great pyramid of Menes was built, in the fourth dynasty of Egypt, B. C. 3893, we find one vast and expanded system of idolatry throughout Asia, and the countries bordering on the Mediterranean, all worshiping emblems, more or less types of the sun or solar principle, China standing alone—far back in the twilight of history—is a solitary exception on the continent of Asia.

Language is a test of social contact, not of race. Undoubtedly the first expression of human thoughts were by configurations of countenance, such as smiles and scowls, indicating pleasure, dread, or anger. With the invention of complicated forms in language, capable of complete expression without emotion, came deceit, frequently followed by loss of harmonious social relations, and developing combativeness. No primitive history, at present known, conveys any reliable account of an aboriginal language much anterior to that of China; although that of the ancient people of Yucatan and adjoining American nations, as shown by picture-writings on their monuments, appears to have been more ancient.

Both peoples, in common with the Egyptians, expressed thoughts by picture-writing and in hieroglyphics. While other surviving nations improved upon this original style, by developing the phonetic; inhabitants of China alone, became exclusively confirmed in their monosyllabic language, and their manner of vocal communication, is still very peculiar and spasmodic in sound and utterance. Their hieroglyphics, which, in early ages, expressed a single substantial thought, were subsequently assumed as syllabic representations, and became synthetic or compound forms of expression. Thus, to-day, 216 Chinese radicals are made use of, in over 50,000 ideographic combinations.

To investigate this subject, requires extensive research in a multitude of directions—physiological, linguistic, religious, traditional geographical, and migratorial—for it is often by their mutual comparison only, that satisfactory results are reached. The wider view we can compass, the clearer our understanding of general laws. There is in force a law of decreasing vitality, as well as of evolution, both alike depending upon the refinement of surrounding conditions. Great disturbances have affected the earth's surface and all living things, since the tertiary period, when our present zoölogy fairly started

into being. To all these considerations, must be added the ancient migrations which the different families of mankind have passed through, under the changing conditions imposed upon them by geographical and climatic necessities, and thus a systematic arrangement of facts is finally indicated. Physical geography teaches us that of the two great elements, water and land, the latter, which is matter in a more advanced form, is far superior in the animal and vegetable life to which it gives origin; likewise, that low and swampy land is fatal to health and the highest development of man. Geology and Palæontology show this to have been equally true of the *flora* and *fauna*, in ancient days.

Neither tropical Africa nor Asia are adapted to the Anglo-Saxon constitution; every white colony there has been wasted by sickness and death; yet this is the native and natural climate of the dark races, who are there as much at home as is the polar bear on the shores of Greenland. When at Saigon, on the Meikong river, I was told by an officer of the French colony, that 24 per cent. of French troops stationed there died annually. The British occupation of low lands in the southern portion of India, is scarcely more than a military possession, so far as Europeans are concerned, who cannot long live there, but would soon become extinct but for the constant influx of fresh immigration. There, a European struggles for existence, a prey to fever and dysentery, and is unequal to severe labor. White women, as a rule, are especial sufferers, rallying but poorly from any illness. White men must yield the tropics to the dark races. The reverse is also true; negroes are not comfortable in the frigid zone. The American residents of New England States, as at present constituted, have a continual fight with existing conditions of climate, and their survivors and descendents, now in process of acclimatization as a race, are assuming a somewhat typical form.

Whenever we examine nature, we find a perfect adaptation of animals to the circumstances under which they live. The constitutional temperaments of the different races seem to vary. The dark races are less developed than the white; they have a less nervous sensibility, for their physical organization is less delicate. Van Amridge says: "The dark races expire less carbonic acid from their lungs than the white, but transpire the fetid matter chiefly by the skin." According to Dr. Knox, the nerves of their limbs are one-third less than the Saxon of equal height. Great differences of shape in the pelvis of different races, have been classified by Doctors Vrolik and Weber, who thus report the four principal races: "The European is oval; the American, round; the Mongolian, square; and African, oblong."

The characteristics most relied on for the discrimination of races, are the color of the skin, structure of the hair, and conformation of the skull and skeleton. Transitions from one to the other are so gradual, that it seems almost impossible to draw any exact and arbitrary line of inter-demarkation. We now see the various branches of mankind confined to distinct localities, mainly bounded by isothermal lines, with distinction of form and color, with different social relations, religions, governments, habits, and intellectual powers. Wherever men have migrated, they appear to have found and displaced an aboriginal nation, and no record is believed to exist of any people ever migrating to a land which they found entirely destitute of inhabitants,

in some of the various stages of human development. Adelung reckons the total population of the earth as 1,288 millions, professing 1,100 forms of religion, among which there exists 3,664 known languages or dialects, viz.: 937 Asiatic, 587 European, 276 African, 1,624 American. These are significant facts.

Sir Charles Lyell is inclined to admit that an imperfect form of man was living when the tertiary stata was deposited. Agassiz, who pronounced America the oldest continent extant, measured the coral growth during a given number of years along the southern half of Florida, which, he asserts, has been formed by accretion during the geological period known as recent, and must have required not less than 135,000 years to form. We may arrange epochs in their order of sequence, but not of date, for in contemplating the vastness of such a past, the mind becomes lost in amazement at the vista opened into antiquity. The histories of China contain records of the past, which modern chronologies have insufficient room to measure. The limits of history are steadily receding, and Greece and Rome are taking their proper positions in a comparatively modern era. Science is developing unanswerable proofs of the greater antiquity of the human race, than current ecclesiastical histories have been supposed to allow. Greater freedom in chronology is absolutely necessary. No sound religious principles have aught to fear from true interpreters of antiquity. Truth, in all its natural simplicity, is susceptible of proof, and reason is its steadfast supporter. Nature's own religion is grander than any human conception. In the dark ages, mysteries, miracles, and absolute imposture stood in the way of absolute truth. Evolution gives to the Infinite higher attributes, and more nearly connects him with all created things. The God of the true scientist is grander and more comprehensible to mankind. It takes us half our lives to unlearn and eradicate errors honestly taught us in youth, with perfect good faith and intention, which persistently cling to us until displaced by the sound reasoning powers of maturer years. Each conscience is but the result of its own moral education. It is composed of ideas it has fed on. Many imbibe, hereditarily, the opinions of their forefathers, and venerate them because they were first upon their mind, which circumstance alone produces to them an unsophisticated conviction of their truthfulness. None are free but those whom Truth makes free:

> "Most men by education are misled,
> They so believe because they so are bred;
> The priest continues what the nurse began,
> And so the child imposes on the man."

America was undoubtedly peopled many ages before Julius Cæsar landed in barbaric Britain, and many of the colossal structures, whose ruins still excite the wonder of the wandering Indians of Central America and Peru, doubtless passed from use long before the Tartar conquerors in Central Asia drove their hordes eastward, or Attila and his Huns swept his legions westward, from the great wall of China and the steppes of Ancient Tartary.

Chinese historians assert that in the fifth year of the reign of Yao, B. C. 2,353, strangers from the south, of the family of Yoüe-Tchang, brought, as a

present from a maritime kingdom in southern seas, a great turtle, three feet long by three feet wide, and very old, on whose back was written a history of the world, from its commencement to that time, which Yao ordered transcribed and preserved. Turtles have long had a peculiar religious significance in Japan, and also among American aborigines at Copan, where a splendid stone altar of great antiquity, in the image of a similar tortoise, yet remains.

Chinese culture, dwelling apart in the south-eastern extremity of Asia, has developed and retained distinctive national types, coldly conservative, while nations less peculiar, and perhaps more adventurous, rose, scattered, and passed away almost by scores. The isolation of their peculiar civilization must have resulted from the physical conformation of the spot they occupied, encircled by protecting ranges of mountains, and forbidding natural barriers.

Eminent Chinese historians, after describing the fabulous and mythical ages, which are imperfect and idealized recollections of events, peoples, eras, and civilizations; and renowned individuals whose exact history had become confused, extinct or legendary, when their first authentic records of ancient history were penned; come to the reign of men. Greek history appears limited when looking beyond into Oriental records, and proves but a scanty stream leading to a broad ocean beyond.

The deified rulers are naturally the most ancient, and are succeeded by demi-god descendents, in a sort of middle age. The advent of conquering heroes from a foreign soil, by introducing a new element into history, may have changed the national era. A careful study of the various ancient histories of the world has led me to infer, that, generally, rulers who are said to have descended from the gods, were merely successful invaders of the country where they died, and were there canonized or deified. Being born in a foreign land, no local record existed of their parentage, and it was easy to ascribe their origin to supernatural causes, while their death being among the people whose traditions have come down to us, was witnessed and recorded.

All scholars experience difficulty in tracing up and locating ancient places, as most of them were given new and foreign names, by conquerors and explorers. Since the days of Tyre and Sidon, and the ancient and long continued sway of the South Arabians declined, and gave way to the rise of great monarchies in Western Asia and India, places have received new rulers and taken new names. This is true throughout history, of all countries, and is more recently illustrated to us, in the saintly names given by Spanish and Portuguese explorers; or head-lands and islands re-named for British seamen and their patrons. A less troublesome impediment to accurate identification, is found in translated names.

The progress of science, and linguistic and historic researches, continually supplements our knowledge of the mighty past, whose history must now be worked back by degrees, and every fact capable of yielding testimony, preserved and utilized. Chinese records, extending to B. C. 3,588, may yet render valuable aid in perpetuating much that was destroyed in the lost libraries of Phœnicia, Chaldea, and Egypt. The first era of Chinese history is without dates, capable of being accurately fixed by any measure known to us

at the present time. So of Methuselah's age. We cannot believe that the duration of human life changed suddenly from hundreds of years to three score years and ten. The change, if at all, was in the human measure. During our present century, the average longevity of Great Britain has increased nearly ten years. The true "*elixir of life*" is a scientific knowledge of the limits of our being, and wisdom to use our powers so as to obtain their utmost capabilities. Wisdom is the best use of knowledge.

This early Chinese era consisted of three dynasties, who, successively with their descendents, ruled the kingdom of China, whose dominion had not then spread into an empire, and the aggregate terms of their reigns must have extended over a long period of time. This period may represent the rule of early Asiatic aborigines, developed upon the soil of China.

Chinese historians commence their second and more authentic era with the reign of a sovereign named Tai Ko Fokee, or Great King Stranger. He commenced his reign B. C. 3,588, and from this founder of their line of monarchs, they have preserved a national history and true chronological succession of their rulers. His name seems to imply that he was a foreign conqueror, who occupied the country, and doubtless, at the time of his conquest, took no pains to preserve the records of superseded dynasties, which come to us only in the form of tradition.

The pictorial representations of King Fokee which have come down to us, represent him with two small horns, similar to those associated with the representations of Moses, the Hebrew law-giver. He and his successor are said to have introduced into China the hieroglyphic characters for picture writing, somewhat similar to those found in Central America, and from whence the ideograms now in use are conceded to have been derived. He taught his people the motion of heavenly bodies, the twelve celestial signs, and divided their time into years and months, besides bringing them a knowledge of many other useful arts and sciences. The sudden advent of so much new knowledge, brought by one man, indicates that he came from far away—from a country with which no previous communication had existed. As he introduced a new measure of time, we can but estimate the duration of eleven reigns which preceded him.

Probably the solar day was the earliest measure of time; then, the lunar month; and lastly, the solar year. The various words used in all languages, and interpreted to us years, meant, simply, the *periods of time* which at the moment constituted its measure. Thus, if Methuselah lived 969 periods of time when the lunar month was the accepted measure, he died at 74½ years of age, which is not improbable.

The great Chinese history of Tse-ma Chi-ang, written B. C. 122, and purporting to be an accurate transcript of all earlier existing histories, which it was desirable to consolidate and preserve; narrates events, chronologically, from the reign of Hoang-Ti, which commenced B. C. 2,697, when he was eleven years old; during his minority the kingdom was governed by wise and prudent counselors, who, it says, took great care of the young monarch, and educated him in all the useful arts and sciences then known. It is recorded that during his reign physicians first learned to feel the pulse; the magnetic needle was first used, pointing to the south; and civilization greatly

advanced. He lived a useful life, was greatly respected, and died at a ripe old age. During a portion of his reign, a powerful revolt was successfully put down, indicating a mixed race, with the antagonisms of conflicting opinions. Five of his descendents succeeded, in turn, to his throne. Then came *Tai Yao*, followed by *Yuti Tsi Yune*, B. C. 2,294, during whose reign a great deluge occurred in Asia, which flooded fifteen provinces of China and drowned great numbers of inhabitants. Some portions of the country remained under water for several years thereafter.

This rupture of a natural barrier, which held in check some extensive inland basin of water, existing at a higher level, occurred just fifty-four years after Archbishop Usher fixes the arch-catastrophe of Hebrew tradition, and was doubtless like the Noachian flood, a crisis in the physical history of the region where it occurred. It is highly probable that the great interior alkaline deserts of North America, where the successive water lines around the surfaces of every elevation of its various levels, clearly indicate the former presence of vast inland basins of water; have at some remote period been, in like manner, drawn off and precipitated upon lower levels of this continent, in their journey towards the common level of the ocean. This is also shown by the presence of ancient river beds across the present summits of the Sierra Nevada Mountains. Nothing seems to impede the execution of unerring physical laws, and in the consideration of general history, natural science shows no relation between such physical calamities and personal guilt.

B. C. 2,233, the next Emperor, *Ta Yu*, caused canals to be cut, to convey to the sea the immense bodies of water which, during the reign of his predecessor, had been precipitated upon and overflowed so large a part of China. By this means many deep river beds were finally cut, and continued to be worn away by the receding waters, until the whole country was freed from inundation.

His eleventh descendent and successor was a tyrant, and was banished in the fifty-second year of his age, and king *Ching Tang* came to the throne, B. C. 1,766, and died 1,753 B. C. During his reign a great famine existed in China, which the records say lasted seven years. Joseph's famine in Egypt occurred B. C. 1,707, or forty-six years after this date. These coincidences are merely cited as suggestive to historical students.

It is desirable that the historical records of all ancient nations should be sought out and compared; and to our linguistic and archæological students on the Pacific, the early histories of China and Japan should be made the subject of careful study. Much mental and social cultivation existed in Asia when Europe was yet in her dark and undeveloped ages. China and Japan, as well as all the nations of Asia, yet contain many ancient records, that may well repay careful study, revealing traces of a civilization whose history is incredibly remote. Ere the ancient respect for sacred records has become impaired, and they are cast aside or destroyed in the ecstasy of a new-found religion, or the mechanical wonders of a scientific civilization, earnest and reliable students may acquire much important testimony among the archives of India, China and Japan. Few ancient races have preserved a literature of equal value with the Chinese. The great past of prehistoric humanity bears traces of activity and commercial intercourse throughout Asia.

About five thousand years before the Christian era, the Sanskrit branch of the Aryan race invaded and occupied Northern India, while the Arabian Cushites, dwelling in Arabia, held control of Southern Arabia. These South Arabians held innumerable colonies, and were unrivaled in power and commercial dominion. They early established great influence as a maritime people along the coast of South-western Asia, colonizing much of the Asiatic seaboard in the deepest antiquity,—not, however, including the present Chinese territory, but exercised a widespread influence from the extremes of India, even to Norway, acting an important part as pioneers in spreading and developing early civilization. The nomadic tribes of Asia have been classed as of Semetic origin.

China, although well known, and mentioned in the ancient Sanskrit writings, under the name of *Yama*, was never included in statements of the migrations of races and peoples throughout Western Asia, Hindostan, and the islands of the Indian Sea. In remote antiquity, the Chinese nation appears to have lived within itself, cut off from active communication with any neighboring people.

According to Arabian traditions, *Ad* was the primeval father of the pure Arabians, and built a city in Arabia which became great and powerful. The Adites are referred to in the earliest dawn of Arabian history, as enterprising, rich and powerful, having great cities of wonderful magnificence. They were skillful builders, rich in gold, silver, and precious stones, showing them acquainted with metals. Numerous appliances of our civilization had their origin far back in the obscurity of ages now pre-historic, and Adam may be but the Hebrew tradition of the ancient Adites of Arabia, who must themselves have had a long line of ancestry, to have developed and acquired such civilization. Adam was, perhaps, simply the ideal embodiment of a *beginning of humanity*, typified to the Hebrews by an Adite patriarch, beyond the experience of their own history, into which he was adopted by Moses, *as the ancestor of their race*. It was an effort to extend their national lineage far back to an original First Cause. The distinctive Hebrew race descended from Abraham, that magnificent sheik, the mighty Mesopotanian prince; Israel's ancestral hero and first distinctive Hebrew personality; great grandsire of the princely Joseph, Lord Chancellor of Egypt, Prime Minister of the first Sesostris, and monotheistic chief of an illustrious line. Thus he stands, in bold relief, on the canvas of tradition, as a great leader of human kind in the period comprised in the first essays of Hebrew literature.

Our opinion of the general inaccessibility of China from other parts of the continent of Asia, in early times, is confirmed by a passage in the history of Besorus, relating the conquests of the Arabian sovereign, *Schamar Iarasch, Abou Karib*, who reigned over Chaldea, and 245 years before the rise of the Assyrian empire carried his arms, B. C. 1,518, into Central Asia, occupied Sarmacand, and for a long time attempted, without success, the invasion of China. Humboldt describes an Himyatic inscription existing at Sarmacand in the 14th century, in characters expressing, "*In the name of God, Schamar Iarasch has erected this edifice to the sun, his Lord.*" All facts go to show that migrations over Central Asia, from Arabia across the continent, must have passed north of China, (which country seems to have maintained

her individuality nearly intact), and reached the shores of the Pacific near the peninsula of Corea, which is still inhabited by a populous nation, quite unlike the Chinese race. Many aborigines of Central Asia were doubtless driven toward the coast by these Arabian conquerors. These South Arabians were a people older than the Aryans. The great ages of Cushite civilization, to which we are told they succeeded, closed at a period which was very ancient when the book of Job, the oldest book of the Hebrew scriptures, was penned as a Persian poem.

Testimony is universal that the oldest nations succeeded older pre-existing peoples, and generally received their highest ideas from abroad, showing a descent of ideas as well as of blood. A constant admixture of races, peoples and nations has been successively going on for ages. It is only in some secluded spot that we may, at this late day, discover traces of anything approaching to an early type, with slight recent admixture. Such specimens, if they exist at all, cannot but be extremely rare, and, like the Miauts of China and some remnants in the Tyrolese Alps, inhabit regions virtually inaccessible.

The huge stone structures, cities and temples being unearthed in Yucatan, argue an enormous early population. The ruins of Copan, and disintegrating pyramids of Palenque, are convincing proof of a great pre-historic race in Central America, at an immensely early period; which must have occupied the same relative positions toward North and South America that Asia Minor did, in remote ages, to Central Asia and Africa. The peculiar construction of all the arches found among the buried cities of Yucatan may lead to the discovery of races cognate to its early inhabitants. The same principle of arch was used in very early times by Egyptians, Greeks, and Etrurians.

Notwithstanding the frequent disastrous fires, and destruction of records by conquerors and founders of dynasties, who have annihilated much valuable material, China, Japan, and the interior of India have many copies and manuscript translations of very ancient works and histories, long retained among their sacred treasuries, rich archæological prizes for modern explorers to unearth, equal in interest to the lost history of Iran, mentioned in the Dabistan and other Asiatic writings.

By an extended research into ancient histories, many plausible reasons are found, which argue the possibility, and almost probability, that some early aborigines of the pure Chinese race may have crossed by sea from the coast of Peru to China in an early or remote age of the world. Recent travelers in Peru inform us, that its aboriginal races have, like our North American Indians, become nearly extinct; and the only remaining traces are found among the China-chola, a mixed result from Spanish and Portuguese ancestors. Last year my attention was called to an article in a South American paper, describing the remnant of a race of aboriginal Mongolians or Chinese, found among the high table lands upon the western slope of the Andes.

Phœnicians and Egyptians, who each received hieroglyphical characters from a common source, originating in an older people, ascribe them to Taut. The Chinese ascribe them to Tai Ko Fokee, their Great Stranger King, who reigned B. C. 3588. Many curious coincidences point to the supposition that

he may have brought them from Peru or Central America, where, among ruins still existing, there has been discovered much early picture-writing, closely corresponding to early Chinese characters, comprising the 216 radical ideographs now used. Thus, heaven is expressed by three horizontal lines, slightly curved; and earth by a cross within a circle. In discoveries at Copan is a figure strikingly resembling the Chinese symbol of Fokee, both nations representing him like Moses, as a lawgiver, with two small horns. Many figures on Peruvian water-vessels, of great antiquity, are identical with those found in Egyptian temples; birds' heads, for example, attached to figures resembling a comma, but intended to represent tongues; and other remarkable coincidences. Either one people learned from the other, or both acquired these forms from a common source. Many physico-geographical facts favor the hypothesis, that it is more rational to conclude that Egypt received them from America, through China—possibly through Fokee, or some predecessor in very remote ages. Recent scientific explorations are reported to have exhumed Chinese sacred mottoes, carved on tombs in Egypt—counterparts of phrases in use to-day—revealing the existence of an intercourse when China was ruled by kings anterior to Moses.

The present written language of China is undoubtedly an imported method, advanced from such picture-writings as those of the ancient Peruvians, or primitive hieroglyphical signs of ancient Egypt. Among some nations, mental progress evolved a simple alphabet, while others remained content with the increasing complications of ideographic signs, for syllables and objects. Egypt, like China, was tenacious of her individual peculiarities, and long retained her hieroglyphic type. She finally abandoned it, while China clung to but improved it.

The South Arabians and their descendants, the Phœnicians, having an extended commerce established throughout the Indian Ocean, with every known shore, undoubtedly passed more readily into a simple phonetic alphabet, better adapted to the practical wants of a commercial people. Tablets have been discovered among their ancient ruins, by which the various changes are readily traced.

Chinese characters, so long surrounded by the ultra conservatism of an impenetrable isolation, have undoubtedly developed from these common forms of natural objects, and subsequently been adapted to easy and rapid writing, with a peculiar style of brush, and their manner of holding it.

The consideration of whether the Chinese people originally developed in Asia or abroad, bears an important relation to the origin of the Japanese race, the subject we are ultimately investigating and shall consider in our next paper. In seeking the initial points whence migrations have diverged, we naturally gather all possibilities, whence we select probabilities, in the hope of finally eliciting absolute truth. We shall be compelled to limit this already lengthy paper to setting forth certain fundamental principles useful in research; and to a collection of evidence, the full discussion of which will necessarily remain for a future occasion.

Without, in any manner, endorsing the following hypothesis, we shall simply aim to shadow forth a few *possibilities*, which the consideration of many curious facts have suggested during the laborious details of an elaborate search.

How came the Chinese—a people so ancient, so reserved, and so wholly unlike their surrounding neighbors, or indeed any other race upon the continent of Asia—to be thus alone in this corner of a continent, walled in apart from all neighboring races? We may reasonably doubt the assumption of any spontaneous growth in the country they now inhabit. Conjectured migrations among still speechless societies, at an epoch anterior to the formation of nations, are beyond our present ability to trace. We can only surmise whether each continent evolved a type of manhood separately, or whether all higher races have resulted from the various differentiations and dispersions from a single locality, of a common ancestor already developed up to the lowest types of a speechless animal, tending to manhood.

Our best researches indicate an enormous antiquity for man on the American continent, and an advance in general form and brain capacity, with, doubtless, a modification of color, since a very early period. In very remote times, there appears to have existed at least two very distinct populations, differing, in fact, more widely than any existing aborigines of the continent. Portions of North America had been occupied by races far more advanced than its occupants when recently discovered by Europeans. Originating, perhaps, at a very early period in the elevated centres of the American continent, wave after wave of races may have rolled eastward and westward, or northward and southward, to a certain extent, only identified in America to-day by slight signs that mark the nearly extinct descendants of the people with which they amalgamated.

Dogmatic theology retreats before scientific truth. No one will, at this day, pronounce the self-registering records of nature grave heresies. They are vastly more enduring, authentic and reliable testimony than the precarious text of human narrators. It seems a crime against true religion to hang the integrity of its moral principles upon the validity of statistics in any book which merely illustrates, by historical parables, the early development of its traditional ideas. The innate virtue of its pure principles is unharmed by legendary or dogmatic absurdities.

The Chinese have an immense antiquity. They are a peculiar people, very marked in their features, and have multiplied so that at present their population and area of production are so balanced that any marked increase would precipitate a famine, and thus equalize conditions. They not only practice economy, but enjoy it, having learned in centuries to live upon the minimum and enjoy the maximum of life.

All other civilizations and emigrations throughout Asia appear to have moved from Asia Minor, and the high central portions of the North and West. The Chinese appear as an isolated people, and have long preserved the peculiar type of a race wholly unlike any other on the continent of Asia. Their country is situated upon the south-eastern extremity of the continent, and hemmed in on the west and north by a chain of mountains practically impassable, and now made more so by the great wall, 1,250 miles in length, with which, B. C. 220, they sought to complete their isolation.

If this people did not develop from the soil they now occupy, we must search for the most probable mode of access by which their earliest ancestry reached their present home. In this stage of the world, all nations are more or less composite.

The southern and south-eastern portions of China border upon the ocean, and if the earliest Chinese came from an opposite direction they must have reached their country by water. If so, it may account for their skilled boatmen, who have lived upon the water from time immemorial, and for the enormous fleets of junks, generally of large dimensions, which they possess. A taste early cultivated may have come down through many centuries.

If we first seek for testimony from Chinese records, we find they ascribe their own origin to the southern portion of China. In order to ascertain how they could have reached there by sea, and the direction whence they probably came, we must study natural causes, and seek among winds and currents for the first natural distributing agents, whose influence on navigation has been but recently overcome by clipper ships and steamers of modern construction.

The Pacific is a wide ocean to cross, and fair winds must have been relied upon, for muscles could never have paddled a direct course for such a distance. Where, therefore, is the country, from which they could follow a fair, fixed wind in a straight course, and be brought to land upon the southern coast of China, where they claim to have originated?

We find in the South Pacific, between the southern tropics and the equator, a perpetual trade wind blowing from the south-east. Towards the tropics, it blows more nearly from the south, hauling gradually into the eastward as it approaches the equator. This constant breeze would drive a vessel kept before the wind, from a point anywhere on the coast of Peru, about in the neighborhood of the Chin-cha Islands, by a slightly curved but almost direct line as far as the equator in the direct course for the coast of China.

In the North Pacific Ocean, between the tropics and equator, the north-east trade wind exists, as the almost complementary counterpart of winds in the southern hemisphere, likewise blowing more northerly near its northern limit, and uniting in an almost due easterly wind near the equator. Thus the south-east and north-east trade winds meet, and frequently blow into each other along a parallel line, making a continuous fair wind, uniting them at the equator, and consequently forming an uninterrupted motive power, to their western limit.

Now, if a large junk were started from the coast of Peru, near Central America, and kept off before these fair winds, there is a strong probability that in sixty days she would strike the southern coast of China, about where early Chinese traditions place the origin of their race. This evidence, of natural causes, apparently points to Peru as the possible home of the Chinese ancestral race. What has Peru to offer in support of such an hypothesis?

In Heaviside's "American Antiquities," published in 1868, we find that "some of the western tribes of Brazil are so like the Chinese in feature as to be almost identical." There is thus a *possibility* shown, that the ancestry of China may have embarked in large vessels as emigrants, perhaps from the vicinity of the Chincha Islands; or proceeded with a large fleet, like the early Chinese expedition against Japan, or that of Julius Cæsar against Britain, or the Welsh Prince Madog and his party—who sailed from Ireland, and landed in America A. D. 1170, and, in like manner, in the dateless antecedure of history, crossed from the neighborhood of Peru to the country now known

to us as China. The very name, Chin*cha*, has a Chinese sound, and reads China, with two letters dropped.

For upwards of twenty centuries, Chinese junks are known to have been large, fast, and strong; their people skillful mariners, excellent carpenters, and marine architects. They early possessed the mechanical skill to build junks of comparatively great tonnage, capable of conveying large amounts of cargo and great numbers of passengers. If the measurements of Noah's ark are correctly interpreted, she was larger than any ship of our day. Ship-building, as we have shown in a previous paper, is a very ancient art, known long before the days of Tarshish. We have no history of its absolute inception. Monuments on land endure to perpetuate the memory of a race, but ships are of their nature perishable. A race that could build the magnificent temples and pyramids of Palenque and Copan, in Yucatan, could certainly have their fleets upon the Pacific Ocean, in ages long before any existing record. The construction of a Peruvian or Central American fleet of large vessels, in early ages, capable of transferring to China, if not 100,000 people, certainly quite sufficient to establish a colony, would require far less skill or enterprise, than that which raised the pyramids of either Central America or Egypt.

China had bronzes in perfection during her very earliest ages, and may have introduced them into Western Europe and Asia. Among the most ancient relics found in Peru, are bronze and iron implements. Many Peruvian and Central American antiquities resemble, not modern Chinese, but their most ancient writings and figures. It is not impossible that Cadmus' alphabet, as well as the hieroglyphics of Egypt, may have been suggested and developed from the ancient American hieroglyphics now coming to light, showing such similarity and apparent connection, and which many scholars already consider as the early models, not the results, of Egyptian figures and Chinese ideographic characters.

The Toltec race in America had a god with one arm—so had the Egyptians. The deified Fo—whom they represent with two small horns, similar to those associated with figures of Moses, the Hebrew lawgiver—instructed Chib-ca Indians in Bogota to paint the cross and trigrams used on their inscriptions; and in China, the Chinese historians ascribe to Fohi many new things, among others, how to paint identical figures of trigrams, like those found among the ruins of Central America. With time and perseverance, it may yet be discovered that a knowledge of hieroglyphics came from Peru or Central America to China—a people whose growing commercial intercourse may have spread their knowledge to the ancient monarchies of Egypt.

The recital of facts may be greatly extended, showing a wonderful chain of evidence, which it is hard to conceive can be entirely accidental and coincidental, unless we take the extremely broad and apparently untenable ground, boldly asserting that primitive humanity, through the action of common laws and natural forces, wherever placed, evolves like forms, customs and necessary results, irrespective of variable conditions and individual fancy or free will. Chinese ideas concerning the Tchin, or original eight persons of a supernatural nature who escaped from the sea, point to an origin from beyond seas, or to an early piscatorial age. B. C. 3,588, Tai-ko-Fokee, a king of China from abroad, was deified. China has her ancient pictorial writings.

Fernando Montesino, a Spanish historian, who visited Peru and published his work from 1508 to 1547, says Peru was thickly populated, and had a catalogue of 101 monarchs, with notes of the memorable events of their reign, extending to B. C. 2,655.

Hawks, in his Peruvian antiquities, says that before the Spanish conquest, in the most eminent period of the dynasty of the Incas, the vast empire of Peru contained eleven million inhabitants, which rapidly diminished, until the census of 1580 shows but 8,280,000, and now the valleys of the Peruvian coast contain barely a fifth of what they contained under the Incas. The total present population by census of 1875 amounts to only 2,720,735 souls. A light native is still called a *China-Chola.*

The feast of souls practiced in Central America appears to have been derived from the same source as that of the ancient Egyptians. The Jesuits of the Propaganda report these ceremonies as anciently in practice in China. The ruins of ancient temples found in Central America resemble in form, space, and massive walls, *without roof*, the most ancient temples of Egypt, and many of the carvings are singularly alike.

Traditionary histories among the different groups of the Polynesian Islands indicate that the Hawaiian race came there from the south. The Hawaiian Islands are nearly in the direct line from Peru to China.

While the majority of Hawaiians are probably descended from Malays, their early traditions tell us of the landing of men belonging to a race whiter than their own, upon the southern island of Hawaii, many centuries ago, whom they were at first inclined to consider as gods, but who finally settled among them, and from their wisdom were elevated to high positions. These men undoubtedly came from Central America or Peru, and may have been from the ancient Peruvian empire, or the later kingdom of the Incas, or from that early civilization whose traces yet remain in Yucatan.

It has been sufficiently demonstrated that even frail canoes and boats, either by accident or design, have performed voyages across wide oceans. In 1819, Kotsebue found at Radack group four natives of the Caroline Islands, who had been driven eastward in a canoe 1,500 miles. In 1849 men came from Honolulu to San Francisco, 2,300 miles, in whale boats. And more recently the boisterous Atlantic ocean has been crossed from New York to Liverpool by a solitary man in a dory.

A dozen of the crew of the clipper ship "*Golden Light,*" burned in the South Pacific about 1865, just west of Cape Horn, reached Hawaii in eighty-one days, in a whale boat under sail, and would have run upon the reef at Laopahoihoi, but for natives who swam off to rescue these exhausted people, all of whom survived.

While we have cited facts showing it reasonable to suppose that early Peruvians or Central Americans may have come to China, by the aid of continuous fair winds, it is no less necessary to show the almost insurmountable difficulties which exist during a greater part of the year to impede their return by sea. To beat back against strong trade-winds and the long regular seas of the Pacific, would be a task in which they would surpass our best modern clippers, which now can only make the voyage by running far north and crossing from Japan to the coast of California, upon the arc of a great circle,

and sailing thence southerly, close hauled on the wind, to the neighborhood of Tahiti in the South Pacific, which must then be crossed in an easterly direction, south of the trade winds, which in turn enable them to make northing and reach the coast of Peru. Such a return voyage would require the most skillful knowledge of winds, coasts, and scientific navigation, such as we have only possessed in comparatively recent times, and would also require exceedingly strong and weatherly vessels. There seems, therefore, less likelihood that any Chinese ever reached Peru in pre-historic times by such a route.

Intercourse appears to have existed more recently, but how far it was reciprocal remains to be seen. If it was commercial it was more likely to have been, as reciprocity is the foundation of trade.

In our search for objections to the theory we are exploring we however, find other possible channels of return communication. During the southwest monsoon a fleet of junks might possibly have left China and followed the Kuro-Shiwo, or warm stream that flows along the coast of Japan, with summer winds across to the northwestern coast of America, near our own harbor, and thence gradually have worked its way southward to Central America, keeping along in sight of the coast until it reached the calm belt around Panama. The Abbé Brasseur de Bourbourg makes this statement: "There was a constant tradition among the people who dwelt on the Pacific ocean, that people from distant nations beyond the Pacific formerly came to trade at the ports of *Coatulco* and *Pechugui*, which belonged to the kingdom of Tehuantepec, in Central America. Baldwin tells us, in his "Pre-historic Times," that "the traditions of Peru told of a people who came to that country by sea, and landed on the Pacific Coast. These may have been from the great maritime empire of the Malays, whose dialects have permeated almost every island in the Pacific oceans. Lang says: "South Sea Islanders exhibit indubitable evidences of an Asiatic origin."

The continent of Asia affords more facilities for reaching Polynesia than America, although stragglers from the latter have doubtless added to its island races, and thus created a mixture of customs which, to some extent, may indicate a partial derivation from both. Probabilities favor Asia, both from certain affinities of tongue, striking resemblance in manners, idols, and physical formation.

Commercial intercourse, although not direct, existed and was maintained between China and Egypt, B. C. 2000. Chinese traditions claim for their people the first use in Asia, of ships and the earliest knowledge of navigation and astronomy. Their people first acquired the mariner's compass and believed the sacred magnetic influence proceeded from Heaven, which they located in the South, and from which they claimed to have come. To this day the heads of Chinese compasses point south.

In Peru, the oldest civilization was the most advanced, and had the highest style of art and mechanical skill. "Her people had an accurate measure of the solar year; a knowledge of the art of writing; and made paper of hemp or banana leaves B. C. 1800." The aboriginal Peruvians have had their dark, as well as bright, ages in history. They may have retrograded while their possible offshoot, the Chinese, progressed. Young colonies often grow and prosper, while their progenitors reach a climax and die out. Dis-

solution is the countercharge, which every material aggregate evolved, sooner or later undergoes. Evolution and dissolution bring to us ever changing, but eternally advancing forms, in their cycles of transformation.

The establishment of a race may be possible from a single pair, of strongly marked distinctive characteristics, whose descendants have continually intermarried. Hebrew patriarchs founded nations, and nations thus springing from a single man of pronounced character, whose descendants remained united and isolated, have often developed strong and peculiar personal characteristics, which have pervaded and stamped themselves upon the race thus descended. Mixed or cosmopolitan races, never possess uniform characteristics as clearly defined.

It seems more reasonable to infer, that a fleet from the neighborhood of Peru may have reached China with the first emigration, perhaps bearing a hero-sovereign and an invading army, which, once landed, found China agreeable, and, being unable to return against those perpetual winds which brought them so swiftly, were compelled to establish themselves in new territory.

Writers on Central America have expressed a decided opinion, that the peculiar character of its ancient civilization, manners, customs, and general structure of the ancient language, point very strongly to a common origin between the Indo-Chinese nations of Eastern Asia and the ancient civilization of America, which appears, in some remarkable particulars, to have been of an Egyptian cast. The Coptic or ancient Egyptian language, however, seems to have been monosyllabic. Hieroglyphic writing is of three kinds: figurative, symbolical and phonetic. Hubert H. Bancroft, in his Native Races of the Pacific States, Vol. V, f. 39, says: "Analogies have been or thought to exist between the languages of several of the American tribes and that of the Chinese. But it is to Mexico, Central America, and, as we shall hereafter see, to Peru, that we must look for these linguistic affinities, and not to the northwestern coasts [of America], where we should naturally expect to find them most evident." Count Stolberg, quoted by Humboldt, is of the opinion that the Peruvian cult is that of Vishnu—one of the Brahmin trinity—when he appears in the form of Krishna, or the Sun.

Mexican kings, who reigned previous to the Spanish conquest, all added Tzin to their names as a reverential affix. It resembles in sound a dynasty of China—the Tsin dynasty—which reigned from B. C. 249 to B. C. 205. Tai Ko Foki, the Great Stranger King of China B. C. 3588, or later Hoang Tai, may have landed from such a fleet, and been called by conquest, or through the reverence of superior knowledge, to reign over them. The descendants of these early settlers may have remained clannish, keeping apart, as an entirely distinctive race, from the Miauts or original aborigines, naturally following the customs of their forefathers, and thus have increased and grown into a mighty nation, unlike all people around them.

During many centuries of growth, China, like Japan and Corea, became a sealed empire, when no possible admixture of foreign blood could occur. It seems to have become an established habit with these nations to periodically close their ports to foreign intercourse. Some similarities of race exist between some types of the Coreans and Japanese, while the Chinese are

quite singular and unlike. Their oriental peculiarities, which strike the casual observer, are their dress, shaved heads and queues, habits, odor, and guttural language. Chinese are the only nation on the continent of Asia that use chairs and tables. Isolated nations, like hermits, cannot escape being distinguished by eccentric habits. Now, if the high civilization of Peru, which was in full tide B. C. 1800, and probably many centuries before, crossed to China in very early days, bringing its accurate measure of the solar year, and the arts of making paper and writing, all the necessary material was furnished China for the production of correct and reliable historic records. In reviewing Chinese early history, we have found that, B. C., Tai Ko Foki, their Great Stranger King, introduced a knowledge of these things, with hieroglyphic characters, and first divided time for them into lunar months and solar years. And we have shown that the authentic comprehensible history of China begins with his reign.

Now we inquire, did Foki, with all this valuable knowledge, come from Peru B. C. 3588, and settle among a pre-existing people, perhaps similar to, if not the aboriginal Miautz, long since driven from the plains of China into the almost inaccessible fastnesses of its mountain barriers?

A knowledge of days already existed among the sun-worshipers of Asia, who doubtless kept their records in days; but the introduction of a scale measuring by months and years placed their history on a footing we can comprehend; and the introduction of the art of writing enabled them to perpetuate it by enduring records. When we discover the measures of time, used to gauge ancient histories before these improvements were introduced, we shall doubtless find their records reasonably authentic. We have as little understood their stupendous figures as strangers conceive the value of a Brazilian rea, some 1000 of which, make a sum equal to the United States dollar; and accounts involving such currency bear the formidable aspect of immense sums, to the uninformed. With advancing centuries, the measure of time doubtless lengthens.

After the children of Israel left Egypt, where the solar year was known, records of extreme longevity disappear, and ordinary terms of life are adhered to. We should judge cautiously, and refrain from any interpretation at variance with human reason and common sense. The lunar changes, without doubt, were employed in the measurement of time in all warm climates before the introduction of the solar year. The colder the winter, the more marked the year became as a measure of time. Day and night would naturally suggest themselves as the first measure. Peruvians, Chinese, Egyptians, Hebrews, Japanese, Polynesians, and others, all attribute great longevity to their earliest ancestry, until the introduction of higher mathematics and the solar year.

The oldest histories preserved to us become what in our day we call authentic, when their nations acquired the art of writing, and divided time in a regular and uniform manner, by the solar year.

The first and fabulous epochs of most histories begin with dynasties of deified warriors. The tendency to deification exists among all early nations, and we need not go out of our own history to prove it. Edmond the Confessor, the Archbishop of Canterbury, who died as late as 1242, was canonized as a

saint, only a differentiated form of the same tendency. The gods of antiquity were partly impersonifications of natural forces, and partly deified men. They often bear the same relation to facts that shadows do to forms, being at worst but simple distortions of the truth. Few nations can examine impartially the substratum of their ancestral religious creeds. How often do we find in dogmatic theology the imprint of early paganism? The Hawaiian nation is supposed to have a considerable antiquity. From time immemorial there have been persons appointed by the government to preserve, unimpaired, the geneology of their kings, which in 1863 embraced the names of more than seventy. Allow an average reign of twenty-five years, this would throw their history back 1,750 years, to A. D. 117 or earlier, say to about the Christian era.

It was a custom throughout the islands of the Pacific to exterminate their enemies, either by killing or setting them adrift in canoes. The latter practice not only led to the peopling of the various Polynesian islands, but was also a cause which led to cannibalism, for want compelled the exiles to subsist on each other, and a taste once indulged in, was continued by survivors who succeedeed in reaching some island, and thus cannibalism became established. North American Indians have never been cannibals.

When Spaniards first visited America, the western equatorial regions of the continent were the seats of extensive, flourishing and powerful empires, whose inhabitants were well acquainted with the science of government, and had evinced considerable progress in art. Roads fifteen hundred miles long, remain in Peru, relics of the past, as ancient as the Appian way. In very remote times social etiquette was observed and universally respected. The early Peruvians constructed suspension bridges across frightful ravines, and moved blocks of stone as huge as the Sphinxes and Memnons of Egypt. They built aqueducts of baked clay and constructed dykes and causeways, and preserved a memory of past events by picture writing. They had a language of ceremony or deference, with reverential nouns and verbs, with which inferiors addressed superiors, a feature of resemblance to the Chinese in Eastern Asia.

Ruins of extensive cities and fortifications are now found in Yucatan and regions of Central America; the elevated plains of Bogota and *Cundinamarca;* the open valleys of Peru; and the lofty, secluded and highly fertile tracts of Chili. These colossal remains of ancient primitive civilizations are passing from the memory of a degenerate offspring, who now behold with indolent amazement these interesting relics of their illustrious predecessors. The origin, history and fate of these powerful nations of America, who have left behind them such colossal memorials of an ancient civilization, is a study of profound interest. Stones, thirty by eighteen by six feet, are squared and hewn and reared with utmost exactness. Their style of arch is peculiar. Temples, pyramids, tumuli, and fortifications, with remains of buildings of singularly massive architecture, often exquisitely carved, betokens a civilized antiquity.

... seems impossible that these people should have passed from the conti-... f Asia by Behring's Straits, for no traces of any such people remain any ... along that route.

Pyramids of remote antiquity are found in India, China and Tahiti, as well as in Egypt and South America. Those of Egypt are in the best state of preservation and perhaps therefore the most recent.

The learned Bavarian, Dr. Von Martius, regards the evidence incontrovertible "of the existence of the *aborigines of America* long anterior to the period assigned in Hebrew chronology for the creation of the world;" a race whose utter dissolution manifests that it either bore within itself the germ of extinction or attempted an existence under most fatally unfavorable conditions.

Dr. Clarke says: "No race of human kind has yet obtained a permanent foothold upon the American continent. The Asiatics trace back their life in Asia so far, that the distance between to-day and their recorded starting-point seems like a geologic epoch. The descendants of the Ptolemies still cultivate the banks of the Nile. The race that peopled Northern Europe when Greece and Rome were young, not only retains its ancient place and power, but makes itself felt and heard throughout the world. On the American continent, races have been born, developed, and disappeared. The causes of their disappearance are un-liscovered. We only know that they are gone." It remains to be seen if the Anglo-Saxon race, which has ventured upon a continent which has proved the tomb of antecedent races, can produce a physique capable of meeting successfully, and advancing under, the demands that our climate and type of civilization make upon it. This is an interesting query.

If we have been utterly confounded in contemplating the stupendous monuments of Egyptian magnificence, which continue to defy the ravages of time, what shall be said of remains of more ancient pyramids and colossal figures in America, of a style and character analogous to those of ancient Egypt, whose very stones are crumbling to decay, and on whose flinty sides verdure has crept over the dust of ages, until ancient and gigantic forests have acquired root-hold, and grown over their very summits? Many an Alexander and Napoleon of pre-historic times has gone to his rest, and left no record, capable of enduring to the age we live in, to mark the glory of his empire. Many mummies are found in Peru, enveloped in bandages of fine cloth, while the bodies of kings are admirably preserved by means of a secret known only to the royal family.

In the far distance of remote antiquity, successive peoples have risen to importance and passed away, long ages before the birth of those from whom the faintest ray of civilization has remained to cast even a feeble reflection of its pale light upon the fading pages of our most ancient historic records.

A period has undoubtedly existed, in the primitive history of our earth, when the necessary equilibrium between its external and internal forces has been lost. When the external pressure on the crust became diminished by the sublimation and recomposition of external elements, which, when refined and advanced, were unequal in density to the expansive force of igneous materials confined in the interior mass. The solid enveloping crust of our sphere is the medium constantly acted upon, by these contending forces, in seeking a state of equilibrium. Geologists direct us to many prominences in which the upheaved strata, on one side, is abruptly broken, and on we other, gently inclined. Such ruptures could not have been gradual, the places the whole combined strata is fractured, depressing portions,zed dis-

ing others to immense heights. Earth's surface, to-day, bears unmistakable evidence, to every thoughtful student, that eruptive catastrophes have materially changed its geological features—especially the levels. Many areas, formerly submerged, are now dry, and known as alluvial formations. Seas have changed position, and rivers acquired new courses. New land has been formed, and mountain ranges reared by upheaval. Recent deep-sea soundings of the U. S. steamer *Tuscarora*—commander, Belknap—clearly illustrate how largely the bed of the Pacific Ocean—once but an extended valley, running, perhaps, from the Arctic to the Caribbean Sea—may have augmented its area by a comparatively moderate depression. During the glacial period, immense icebergs were produced at the poles, and as they increased in bulk, during a succession of cold winters, they accumulated an enormous volume of water—human life is considered to have been extant at this period—and when a succession of warm summers, produced by the perpendicularity of the earth's axis to the plane of the ecliptic, succeeded in reducing these huge accumulations of polar ice, its volume retired, covering many valleys not previously submerged. This could have given rise to the legend of a Flood, which may have occurred, but could not have been universal, for a sufficient amount of water does not exist to cover the highest mountains, and submerge the entire earth.

A sudden and eruptive convulsion of earth's crust during the tertiary, near the close of the cretaceous period, whether separate or conjointly with a flood, must necessarily have destroyed a large majority of partially developed men, struggling to evolve the higher human types. Portions of Asia, Africa, and Australia are supposed to have been elevated; while Europe, the extreme northern portions of America, the Caribbean Sea, and the beds of certain oceans were depressed. The effects must have been most forcible around the poles and south of the equator. Dead river beds which cross the highest mountain ranges of the Pacific Coast, and yield so largely of gold to hydraulic washing, clearly confirm radical changes in the physical conditions and levels of this coast.

The surviving remnants of these catastrophes, in Asia, Africa, Yucatan, and a few scattering tribes of North America, thenceforth appear as the progenitors of all living nations. It is only from this period that we can hope to trace the early history of humanity. Previous beings, if in harmony with physical conditions, must have been generally in the incipient stages of human evolution. In Central America alone, we find ruins, whose hoary antiquity seem to claim for its inhabitants the earliest civilization of which any traces remain. It is fair to infer that the pyramids of Yucatan were antediluvian and escaped inundation, as did the cities of Palenque and Copan. These elaborately constructed cities of Central America exhibit conceptions of beauty which, as early specimens of a gradually unfolding art, appear to antedate all similar structures extant.

Plausible grounds of inference exist, that the earliest manifestations of culture known to us, was among the primitive settlers of Central America, who, having acquired mechanical invention, art, and the rudiments of science.

built dwellings and temples, which yet endure as testimony of their Although their minds were doubtless uncultivated in tho e higher of knowledge and refinement which ensures perpetuity to national seem to have led the world in the early use of language, and the ad picture-writing to record and communicate ideas.

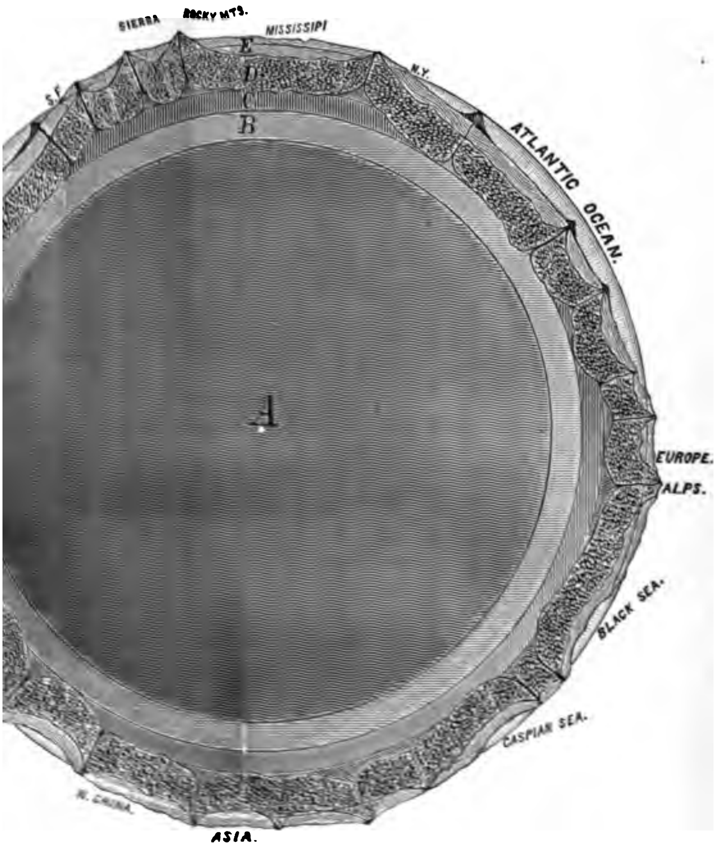
The sun, which was long the national emblem of Central Americai is the absolute basis of mythology. It seems probable that Yucatan tended over the present bed of the Gulf of Mexico, including the We Islands. The Caribs may be a degenerate remnant of some aborigi The ancestors of our North American Indians were very uncultivate physical, mental and social condition.

Long before Egypt, the progenitor of Greece and Europe, was se inhabitants of Yucatan appear by their monuments to have been vanced in general intellectual attainments, and to have led all know in art and science. Why may not a branch of this people have e to China and Egypt, and there have become a large and advanced na

Many things unite to prove that China, at the opening of her tre to European trade, was unmistakably retrograding in the physical a social organization of her people. Her highest prosperity is though been reached about the reign of Genghis khan.

Agassiz tells us that, geologically considered, America is the ol tinent. If so, why should we not look to it, as the spot where th race first gained ascendancy, and acquired its primeval home? If tive races have died out, and stone pyramids crumbled beneath the c not a strong argument in favor of her antiquity? In Asia, traces y of original races, whose earlier civilization in America, under differe cal conditions, *has had time* to culminate, dissolve, and *fade fr* When, in the early development of America, progress was sufficient tate emigration, why may she not have furnished population to A submitting this question, with evidence calculated to warrant furth and outlining various channels for investigation, we aim to attract fo scientific attention which, as an ethnological problem, it fairly deser ing some satisfactory answer may be attempted, before facilities for i tion yet available among American aborigines, shall have passed awa

This imperfect collection of facts is laid before the Academy in it condition, not in any way to ask for present endorsement, but t new sources of inquiry among thoughtful ethnologists, which may u lead to a discovery of the truth. A large mass of additional facts upon this subject require more labor than I have yet found time t and would also unreasonably swell this already lengthy paper, offered as a simple inquiry, suggested to careful and technical s who, by comparing physical, embryological, and linguistic chara pertinent histories, and traditions, may in future establish or disp possibilities here shadowed forth.



A. Meteoric Iron. Central mass.

B. Basaltic Lavas.

C. Porphyry Trachytes. Pumice, etc.

D. Granite Zone.

E. Stratified or Secondary Rocks.

SECTION ON FORTIETH PARALLEL N. (AFTER PROF. HITCHCOCK.)

(SEE PAGE [illegible].)

Regular Meeting, May 17, 1875.

Vice-President Edwards in the Chair.

Fifty members present.

Gustave Mahé and Ernest L. Hueber were elected resident members.

Joseph L. King and Pembroke Murray were proposed for membership.

Donations to Museum: Sponges and tertiary fossils from San Diego, by Henry Hemphill; concrete gum, from C. B. Smith; archil from Mazatlan, and Epiphites (Abies Douglassii), Henry Edwards; fragments of wood from a well 180 feet deep in Alvarado, Alameda County, California, from John Hall; Indian Mortar, from Amos Bowman; fine specimen of peacock (mounted), from James Lick; portion of skull of *Ursus horribilis*, from M. O'Hara; snake from Master Willie Lockington.

Wm. Guerin read a paper on "The Sewage System of San Francisco."

Mr. Stearns read a paper by J. E. Clayton, of Salt Lake, as follows:

The Glacial Period—Its Origin and Development.

BY J. E. CLAYTON.

In the summer of 1860, I discovered the markings and terminal moraines of the Glacial system of the Sierra Nevada mountains, on the head waters of the Merced and Tuolumne rivers.

Upon my return to San Francisco, I reported the facts to the California Academy of Sciences. Since that time I have been a careful student of the glacial phenomena presented on the western slope of the continent. In other portions of the world, the phenomena of the Glacial period have engaged the attention of scientific investigators, ever since geology became a science.

Many theories have been suggested to account for the sudden change of the climate of our planet, at the close of the tertiary age, from temperate and tropical heat to that of arctic cold. The theories put forth by the ablest

writers on the subject have failed to account, satisfactorily to my mind, for the most important facts observed. Many of these theories are based upon an assumption of conditions and causes that cannot be maintained by logical deductions from the general laws governing the progressive development of the planet.

I will review briefly some of the theories put forth by eminent scientists, by which they attempt to account for the great changes in the climate at the close of the tertiary age.

THE FIRST THEORY

Is, that there occurred a great upheaval of land in the Northern Hemisphere, by which the currents of the ocean and of the atmosphere were greatly changed or modified, and that this great elevation above the ocean level was the primary cause of the change of temperature. This line of reasoning appears to me untenable, for the following reasons: 1st. If the elevation of the land surface had of itself sufficient influence on the climate to produce the Glacial epoch, it ought by the same law to have continued that condition until the present time, and to an indefinite period into the future ages. As this supposed cause has not been sufficiently potent to continue glacial conditions, it therefore follows that it was not the primary cause of climatic changes, but was merely a modifying influence, in so far as it changed to a limited extent the direction of the air currents.

2d. The thermal effect of the sun's rays upon land surfaces is much greater than upon water surfaces. Hence the atmosphere becomes heated by its contact with the land even at great altitudes. The land surface of the North American continent will probably not exceed an average altitude above sea level of more than two thousand feet. Compare this altitude with the different heating power of the sun's rays upon land and water, and the change would in all probability be an increase of atmospheric temperatures.

3d. The effects of the elevation of the continents would be to largely increase the land surfaces, and correspondingly decrease the areas covered by water. The interior basins or inland seas would be drained off, the watersheds steepened, so that the surplus rainfall would be rapidly drained into narrow, swift-running streams, thus reducing the sources of vapor to very narrow limits as compared with the water surfaces in the beginning of the tertiary age. It therefore follows that a largely decreased evaporating surface, and a correspondingly increased thermal effect of the sun's heat, could not supply the conditions for a continental glacier system. Hence I conclude that the elevation of land surface in the Northern Hemisphere was not an adequate or primary cause of the Ice period.

SECOND THEORY.

Some investigators suppose that, by some means, the relative positions of the poles of the earth have been changed, so as to bring the then frozen zone into the range of the now temperate and tropical latitudes. As a proof of this, they cite the facts that the remains of vegetable and animal life, that are

now peculiar to the tropics, are found in abundance in the polar regions of our time. By what means a self-balanced rotating globe could change the position of its mass, without changing its line of rotation, is not shown by the advocates of the theory; and unless the cause of such change can be clearly shown by facts that cannot be accounted for in any other way, the theory cannot be accepted as even probable.

If the general proposition is true, that the earth was originally incandescent, and has been slowly cooling through past ages by radiation, it follows that the conditions for tropical life must have begun near the poles, and progressed toward the tropical zone, in harmony with the changes of climate. If no violent disturbances of level had taken place, the change would have been slow and almost imperceptible; but we know that violent changes in the earth's crust have taken place, and have produced rapid if not sudden changes in the temperatures and climates of its surface. These changes have been sufficiently violent to destroy the characteristic types of life existing at the time, and mark a distinct period in the progress of the globe toward its present condition. I therefore conclude that the theory of a change of the poles of the earth is not susceptible of proof, and therefore unworthy of serious consideration.

THIRD THEORY.

Another class of investigators, failing to apprehend the true causes which produced the Ice period, have proposed the theory that the solar system, in its sweeping circle through space, has encountered or passed through frigid zones in the stellar spaces that reduced the surface or atmospheric temperature to an extent sufficient to give an Ice period to our climate.

This theory, like the one above considered, has not been proved by any well considered facts, neither is it susceptible of proof by any known means within reach of human investigators. If this theory were true, the waters of the globe would have been frozen where they now are, and could not have been transferred to any considerable extent, by evaporation and condensation, upon the land surfaces.

The extinction of life would have been a slow, starving and "freezing out" process, that could in no reasonable way account for the facts of glacial times. The conclusion therefore follows, that cosmical influences had nothing to do directly, in producing the Glacial epoch at the close of the tertiary age. The facts, so far as I have been able to trace them out, all seem to indicate that the geological disturbances and volcanic eruptions that occurred at the close of the tertiary age, together with the return trade winds, were the only causes, ample and sufficient to produce the facts and phenomena of glacial times.

The question then may be asked here: What are the conditions necessary to produce a glacial period? The answer is plain and simple: 1st. A folding and dislocation of the earth's crust along great longitudinal lines (N.-S.) along the western borders of one or more continents. 2d. The issue of interior heat, followed by great outflows of lava along such lines of fracture. 3d. The local vaporization of the waters of the surface by contact with the lava

outflows and other points of escaping heat. 4th. The ascent of the vapors to a height sufficient to penetrate the return trade winds, or upper currents of the atmosphere. 5th. The general depression of the ocean beds, and corresponding elevation of the continents, and development of the great mountain chains of the globe.

That such conditions and facts did occur at the close of the tertiary age, substantially in the order named, is well known to every practical student of Geology. That such conditions and facts, in conjunction with the upper currents of the atmosphere, were ample of themselves to produce and would of necessity cause the glacial epoch, cannot, in my opinion, be seriously questioned.

To bring this subject clearly before the mind, it will be necessary to make a brief survey of the physical geography of the continents during the tertiary age. The geological records, so far as science has been able to trace them out and interpret their true meaning, show that, in the beginning of the tertiary age, the continents over their largest areas presented low, undulating surfaces, but slightly raised above the ocean level; that large districts were covered by fresh-water lakes and inland seas, some of them at one period presenting the forms of life peculiar to marine and brackish waters, and at other periods only such living forms as are known to exist in fresh water—thus proving that slight oscillations of the earth's surface were sufficient to cause the oceans to invade some of the interior basins of the continents and fill them with salt water. Hence, in many of the tertiary formations, we have presented the various forms of life peculiar to marine, brackish, and fresh waters. During the progress of the tertiary times, great changes of level were produced over large continental areas, until they became mostly dry land. In the later tertiary period, the marine deposits were gradually confined to the low borders of the continents, and the interior basins became filled exclusively with fresh water, and only fresh-water deposits were formed in their beds.

The climate of tertiary times fluctuated from a tropical warmth, that was well nigh universal over the globe at the beginning, to temperate and even Arctic cold in the higher latitudes, where great elevations of mountain chains occurred in the later periods. At the close of the tertiary age, the disturbances of the solid crust of the earth were enormous. Great mountain chains were elevated on all the continents, accompanied with corresponding depressions of the ocean beds, thus confining the oceans to narrower limits and increasing the land surfaces above the waters.

This last grand change of land and ocean levels must have occurred mainly by sudden convulsions and re-adjustments of the earth's crust. The continued radiation of heat from the fluid nucleus of the globe caused its continued shrinkage. The consolidated crust conformed to this shrinkage by corrugations and oscillations of level. The sinking down of the ocean beds and elevation of the continents went on slowly through the long periods of the tertiary age, until the lateral pressure of the earth's crust became so great that it culminated in a series of dislocations and uplifts over all the continents of the globe. The ocean beds were doubtless equally disturbed and broken, so as to relieve the lateral pressure caused by the shrinkage of the interior.

The immediate effect of this relief of lateral pressure would be the settling down of the broken, folded, and dislocated crust with nearly its full weight upon the molten mass of the interior. This would cause the outflows of lavas through the broken lines, until the fluid and solid portions of the globe were balanced according to their relative densities and weights, just as water will ascend in the fissures of broken ice to the points of equal weight. It would appear from this line of reasoning, that the greatest outflows of lava ought to have occurred where the greatest downward folding took place; and this is strongly indicated, if not proved, by the islands of the oceans being nearly all of volcanic origin, and the lower flanks and plateaus of the continents having the greatest lava outflows.

While we must admit that the changes of level over large areas of the globe were very slow, and extended through long geological periods, we are still forced to the conclusion that sudden changes of vast extent have taken place at the close of the principal eras. These convulsive movements not only changed the relative positions of the land and ocean levels, but also swept away all living forms peculiar to the geological age that was terminated by such changes. The general results following such violent terminations of geological ages would be—

1st. The escape of enormous quantities of interior heat, accompanied by great lava outflows along all the principal lines of disturbance.

2d. The consequent vaporization of large quantities of water, continued through the period of disturbance, and until the lavas were cooled and all the principal vents of escaping heat were closed. In the earlier geological periods, when the average temperature of the earth and atmosphere was much higher than it is now, the waters vaporized during periods of volcanic or igneous activity would descend in floods of rain; but in later times the general temperature became so much reduced by the radiation of heat, and the crust of the earth had become thickened to such an extent, that the atmospheric temperature was dependent mainly upon the influence of the sun.

Under these conditions, the vaporization of the waters by the outflows of lava and hot gases, at the close of the tertiary age, would give results greatly modified by atmospheric temperature. Near the points of igneous outbreak, the lower zones of vapor would descend in floods of rain; but those portions of the continents lying east of and remote from the lines of volcanic activity would be buried in enormous depths of snow. Prof. Tyndall says, "To produce a glacier, we must first vaporize the waters." I think I have indicated how the waters were vaporized. The next thing to demonstrate is the freezing of the vapors, and their distribution over the continents, especially over those portions remote from active igneous disturbances.

A careful study of the wind currents at this point becomes an essential part of the problem to be solved. The currents of the lower portion of the atmosphere are modified in their movements to a great extent by the mountain ranges and continents, but their general tendency is toward the west, as they approach the equator. The upper currents are more uniform in their movements, and they have a general tendency toward the northeast and southeast, moving spirally from the equator toward the poles, in curves of great length around each hemisphere before the polar regions are reached,

where they curve under and again become the lower currents on their return to the equatorial zone.

If the globe was a perfectly smooth sphere of homogeneous material like water, the atmospheric currents could be mapped out with mathematical accuracy; but the unequal surface of the land and the different thermal effects of land and water surfaces produce great modifications of the wind currents in certain latitudes.

This is especially the case along the west coast of the North American continent, where the polar current swings far out to the westward over the Pacific, and the return trade wind, or upper current proper, swoops down behind it to the east and strikes the west coast, and sweeps northeastward over the continent.

This fact is beautifully and conclusively proved by the trees on all the higher mountains from the Pacific coast to the summits of the Rocky Mountains. The scrubby trees in all exposed positions near the higher summits lean east and northeast; even the small twigs are bent around the limbs and trunk in the same direction, so that the whole aspect of the tree presents the appearance of reaching out to the northeast with every limb and twig. These facts show that the wind does blow in that direction (N. E.) almost constantly. The general fact is well known, and I will not go into tedious details to prove what must be readily admitted by hundreds of careful observers.

At the close of the tertiary age, the western slope of the continent was the principal scene of active volcanic disturbance. To comprehend the fearful extent of this disturbance, and the enormous masses of lava outflows, one must travel over the disturbed regions and see them. My powers of description are too limited to undertake the herculean task. The whole western slope of the continent has been broken, crushed and distorted in every conceivable manner. Districts as large as some of the smaller States have been buried to unknown depths with lava and ashes. Large rivers and great lakes were swept out of existence by the overwhelming catastrophe. The lakes, rivers and oceans sent columns of hissing vapors miles in height into the upper air currents, where they were frozen as they were conveyed eastward, and spread broadcast over the more quiet eastern slope of the continent. Thus the waters of the Pacific coast were vaporized and spread over the continent by the return trade winds. All living things were overwhelmed and buried in the sudden storms of snow. The mastodon and kindred tribes were buried up suddenly, with their stomachs full of food, their bodies loaded with fat, and not a trace of any slow process of change in climate from cosmical or other exterior causes.

It was evidently no slow, starving-out process that destroyed the animals of tertiary times, but the sudden and overwhelming effects of a great geological catastrophe.

While the elephant, rhinoceros, and other large animals were being buried in the ashes and debris near the volcanic outbreaks on the Pacific slope, the same class of animals were being covered hundreds of feet deep in snow on the eastern slope of the continent.

Those animals that were not buried, like Pompeii, in ashes and mud near the outbreaks, were overwhelmed and destroyed by the resistless floods of

rain, and the crashing shocks of the earthquakes The snow and ice period of the northeast was contemporaneous with the flood period of the Pacific coast.

No continental glacial system covered the Pacific portion of the United States, notwithstanding the altitudes were much greater; the glaciers were local, and more or less isolated, clustering around the higher peaks of the mountains.

The valleys and basins of this western volcanic region were filled with hot water, hissing steam, and volcanic products. No ice beds could form in the valleys of the Pacific; the hot rocks and escaping gases were busy, vaporizing the waters for the glacial supply of the east. No gentle snow-flakes could find a resting-place upon the table lands and valleys of the volcanic belt; but floods of rain descended, and plowed deep gorges down the steepened flanks of the recently elevated mountain ranges, thus establishing a new river system for the Pacific coast.

The most prominent examples of this are seen on the western slopes of the Sierra Nevada range, in the State of California, where the old river system has been completely buried, first by ashes and debris, brought down by the floods of water from the vents along the higher portions of the range, and secondly by broad streams of lava extending from such vents, to the plains of the valley. Notable instances occur in Tuolumne, Sierra, and Plumas counties. The portions of the old river system that were covered by the lava outflows were protected by them from subsequent denudation, and are now the summit lines of long ridges that divide the waters of the newly formed river cañons.

Under these immense fields of volcanic ashes and lava beds are found the relics of the tertiary life; and not a trace of such life has been found anywhere existing on the Pacific coast since this period of uplift and volcanic activity which closed the tertiary age.

The next notable changes were the development of the new river system, by the changes of the water-sheds and the enormous floods of water that fell for many years near the lines of escaping heat, and the formation of glaciers on the higher portions of the mountain ranges. In some places the glacial action has been traced down the slopes of the granite peak to the lava beds, and for considerable distances on their upper surfaces, thus showing that as the lavas became cooled, the ice pushed its way over their higher portions.

Here we find events well marked in the order of their occurrence:

1st. An undulating, fertile country, of subtropical or temperate climate, teeming with the living forms of tertiary times.

2d. A violent and sudden outbreak of volcanic activity, accompanied by great changes of level.

3d. The destruction of nearly all life, followed by floods of rain to an extent nowhere possible except near the sources of vaporization.

4th. The formation of glaciers on the higher mountains toward the close of the flood period, and as soon as the local temperature was sufficiently reduced to permit their formation.

These characteristic changes were not confined to the California coast. The line of volcanic activity extended from Cape Horn to Behring Strait. In

fact, the whole western slope of the American continent, from the Pacific shores to the summits of the Andes, Cordilleras, and Rocky Mountains, was in active eruption and volcanic disturbance.

If no other parts of the world had been subjected to like disturbances, the vaporization of the waters along this one great zone would have been sufficient to modify its climate; but other portions of the globe were disturbed to nearly an equal extent. And there can be no doubt about the effects of such enormous evaporation of the waters on the climate of every part of the earth; even tropical countries would be covered with snow if the vapors were sufficiently abundant and dense to exclude the heat of the sun for a series of years. The influence of the trade winds or great general currents of the atmosphere, must not be lost sight of; they were the conveyers and distributors of the vapors produced by the escape of interior heat at the various points of disturbance.

By tracing their general courses from such lines of disturbance, it is easy to determine where the greatest deposits of snow would accumulate and form the continental glaciers.

I have said that nearly all traces of tertiary animal life, were swept from the American continent. But such does not seem to be the case with Africa, India, and a part of Asia; there the elephant, rhinoceros, and many other types of life closely allied to the tertiary mammals, remain.

This important difference in the present types of life of the two hemispheres can be accounted for upon the general basis of the theories advanced in this paper. The course of the return trade winds, or upper currents of the air, is toward the east, but constantly diverging north and south from the equatorial line. The American continent is narrow in the equatorial zone, except a portion of South America.

The great volcanic activity along the Pacific slope overwhelmed the low lands with floods of water of such enormous volume, that nearly all land animals were swept off or buried in the debris from the mountains. There is no doubt but all the highlands of the tropical portion of South America were buried deep in snow, if not with glaciers. Now take the line of the upper air-currents across the Atlantic to the coast of Africa, and you will see that the divergence of these currents north and south will divide the vapors, and leave Africa comparatively free from their effects. The west coast of that continent was but slightly disturbed by volcanic activity, and there was not enough local vaporization along its west coast to give it a glacial system or flood period of sufficient volume to destroy its land animals completely.

The same may be said of portions of Asia and India. Hence the preservation of leading tertiary types in the Eastern Hemisphere, and their almost complete destruction in America, must be attributed to the operation of the atmospheric currents in conveying the vapors away from some portions of the land, while they covered other portions to great depths in snow and ice.

Some geologists assert that many of the tertiary mammals existed in North America after the close of the glacial epoch. This opinion should be received with great caution, for the reason that such remains were preserved in the ice and snow of the glacier period; and as the glacial fields slowly moved down mountain slopes and melted away in later times, the skeletons would be

deposited in lakes and alluvial deposits along rivers, and become so intermingled with the remains of more recent times, as to give them the appearance of being contemporaneous.

By referring to the researches of Agassiz, Forbes, Tyndall, and other eminent investigators of glacial phenomena, it will be seen that they admit the influence of the air-currents in glacier-building.

The great return trade-wind current, that sweeps in a curved line across Northern Africa and the Mediterranean Sea, deposits its accumulated vapors in snow upon the Alps, where the glaciers of the present time have given scientists an opportunity to study their formation and movements. and to trace out, to a limited extent, the causes that produce them.

I must beg the indulgence of the Academy and scientific investigators generally, for the incomplete and somewhat crude style in which this interesting subject has been presented by me; but I must express the hope that it is sufficient to call the attention of abler minds to the broader field it opens up for future investigations, and that it will add a little to the sum of our present knowledge of one of the most interesting periods in the geological history of our planet.

Salt Lake City, February 12th, 1875.

Mr. Stearns and Dr. Blake made some verbal remarks on the subject of the above paper.

The Secretary read an extract from a letter by A. W. Kiddie, County Surveyor of Plumas County, confirming the claim of Dr. Harkness as the rightful discoverer of Lake Harkness.

Regular Meeting, June 7th, 1875.

Vice-President Gibbons in the Chair.

Twenty-five members present.

S. B. Christie and Frank Soulé were elected resident members.

A. W. Crawford, Dr. G. King and Dr. F. W. Godon were proposed as candidates for membership.

Donations to the Museum: From F. Gruber, specimens of green-winged teal and blue-winged teal; from Samuel Purdy, galena and silver ore from Utah, bismuth from same place, and

silver ore from Sonora, Mexico. President Davidson donated seeds of wax tree, copper and pheasant skin from Nagasaki, Japan. J. Begg donated specimens of cones of *Pinus aristatus*. Mr. Graham presented a specimen of "Loco" poison (*Oxytropis campestris*) from Bakersfield, S. P. R. R. From Mr. Zellerbach, quicksilver ore from Lake County. J. P. Moore presented specimens of ore from various localities. J. G. Riley presented specimens of ore from Lake County. Specimen of *Picea religiosa*, from volcano of Colima, Mexico, from J. Roegel. A. J. Dennison presented piece of chestnut or ash wood found embedded in piece of quartz from depth of 230 feet from surface, in Lee mine, Elko County, Nevada, on C. P. R. R., Palisade, 472 miles from San Francisco.

Henry Edwards submitted the following:

Pacific Coast Lepidoptera.—No. 12. On some New Species of Noctuidæ.

BY HENRY EDWARDS.

The species of moths described in this paper belong to the group *Anartidæ*, many interesting forms of which have been recently figured by Mr. Grote, in the Bulletin of the Academy of Sciences of Buffalo. Their extreme rarity in collections has always rendered them a favorite division of the family, and more than one of the genera now noted would appear to be confined to the Pacific States and Territories. The genus *Annaphila*, recently founded by Mr. Grote upon a Californian species, *Ann. diva.*, is remarkable for the lightness of the color of the lower wings, the system of coloration much resembling that of the genus *Catocala*. The insects fly in the hottest sunshine, and with the greatest rapidity, alighting only occasionally, when the harmony of color existing between the upper wings and the lichen-covered rocks or trees to which they attach themselves, renders them almost invisible. They are, therefore, very difficult of capture, and can really only be taken while on the wing, the process requiring a sharp eye and a steady hand. Nothing whatever is known of their larval condition. *A. diva*, *A. depicta*, and *A. amicula* are the most common of the group, the remainder being only found in my own collection or in that of my friend Dr. Behr, who has generously placed his unique species at my disposal for description. I have in all cases adopted his MS. specific names as applied to the specimens in his cabinet. The genus *Axenus* is found on flowers in the early spring, the species *Ax. arvalis*, on which Mr. Grote has founded the genus, being common in warm pastures throughout the State, as early as the first weeks in March. It is to be expected that diligent search, particularly in the southern portion of the State, will reveal many other species of these beautiful and interesting moths, and the attention of entomologists is earnestly directed to them.

Anarta Kelloggii, n. sp. Hy. Edwards.

Head, thorax and abdomen, black, with silver gray hairs.

Primaries, black, mottled with silver gray. The basal half line and the t. a. are indistinct, the latter only very slightly dentate; orbicular and reniform, very distinct, the former brownish, the latter surrounded by a white cloud. T. p., bent anteriorly after reaching the middle, distinct near internal margin, and edged outwardly with gray. Sub-terminal line whitish, tri-dentate, edged anteriorly with black shade, most strongly marked on the costa; marginal line black, cut with white streaks. Fringes blackish, mottled with gray.

Secondaries, black, with white median fascia, not reaching to anal margin. Fringes, white.

Beneath, both wings are largely white. Primaries, with the base and a broad sub-marginal fascia, dusky black. Secondaries, with base, small discal spot, and rather wide sub-marginal band, also dusky black.

Expanse of wings, 1.35 inches.

(Coll. Hy. Edwards, No. 5534.)

Taken in Tuolumne County, California, by Dr. A. Kellogg, to whom I am indebted for much valuable material, and to whom, with sincere regard, I dedicate this species. It is allied to *A. melanopa* of Labrador, but differs considerably by the more elaborate markings of the primaries, the much wider black margins of the secondaries, and the darker and more pronounced coloring of the under side.

Anarta crocea, n. sp. Hy. Edwards.

Primaries, grayish brown, speckled with black. Basal half line much bent inwardly at its conclusion. Between it and the t. a., the space is covered by mingled brown and white scales. T. a., which is gray, edged with black, runs obliquely from costa to beyond the middle, then forms a double tooth as it reaches the internal margin; orbicular and reniform, white, well defined; median space darkest towards internal margin. T. p., white, with anterior edge blackish, rounded from costa, and almost lunate in form. Behind it are many white scales on a brownish ground, most strongly marked on the costa. Subterm. consisting of a blackish shade, approaching the t. p. by a series of black dots. Fringe, gray, mottled with black. Thorax and abdomen, light gray, sprinkled with black.

Secondaries, yellow orange at base, with rather wide black margin. Fringes white.

Beneath, the wings are yellow orange, the lower side the darkest, with rather wide black margin, the costa of each sprinkled with brownish scales.

Expanse of wings, 0.85 inch.

Dalles, Oregon. (Coll. Hy. Edwards.)

It is possible that this species may form the type of a new genus, though the similarity of its system of coloration to the European *A. myrtilli*, induces me to place it here.

Melicleptria venusta, n. sp. Hy. Edwards.

Head and thorax, rich chocolate brown; abdomen, black, with the anal hairs golden brown.

Primaries, with the base and outer margin rich chocolate brown. T. a., deeply notched anteriorly in the center. T. p., with a tooth extending outwardly, the space between these lines being cream white, except on the costa, where there is a light brown spot. Orbic., obsolete. Reniform, distinct, ovate, dusky. Fringes, brown.

Secondaries, blackish brown, with large white patch occupying the whole of the center of the wing, but not reaching to the anal margin. In this space near the base are some black scales. Fringes, white.

Beneath, primaries largely white, with costa and base broadly blackish, and a very large and distinct black discal spot. Margins, blackish, widely so at apex. Secondaries, same as the upper side.

Expanse of wings, 1.05 inch.

(Coll. Hy. Edwards.) Kalamath Lake, Oregon. Lord Walsingham.

A most exquisite and remarkable species.

Melicleptria vacciniæ, n. sp. Hy. Edwards.

Anarta vacciniæ. Behr. MSS.

Head and thorax, brown, with a few brown scales; abdomen, blackish brown, with the base of segments whitish.

Primaries, light brown, with a golden tinge; base of the wing darker than the other portion. T. a., only moderately curved, very slightly dentate anteriorly as it reaches the internal margin. Median shade, whitish, brown as it reaches the costa. Orbicular, almost obsolete. Reniform, large, distinct. T. p., whitish, bent considerably outwards near costa, nearly straight towards internal margin. Sub-term., sharply toothed in the middle; resting upon this line are four or five black dashes. Fringes, shining golden brown, with darker patches.

Secondaries, black, with median white fascia, broadest behind the middle, but not reaching to the anal margin. Near the outer margin is a small white streak, suggesting a sub-marginal band. Fringes, white.

Beneath, primaries black, reddish near costa, with broad median band, a kidney-shaped spot near apex, and anteriorly notched marginal band, all cream white. Secondaries, black, with a large space near the costa, reddish white, and a nearly oblong spot in center of wing, cream white. Behind this is also a small white spot. Fringes of both wings as in the upper side.

Expanse of wings, 0.75.

(Coll. Dr. H. Behr.) Sierra Nevada, Cal.

Melicleptria fasciata, n. sp. Hy. Edwards.

Primaries, fawn drab. Between t. a. and base, a slightly darker streak extends along the internal margin, and more slightly along the median nervule. T. a., almost obsolete. Median space, whitish, forming with white fascia of secondaries an almost continuous band. Orbicular and reniform, white, distinct. T. p., blackish, commencing very near the apex, then slightly bent inward, and straight as it reaches the outer margin; behind it a dark externally toothed shade. Margin, whitish, with fringe a little darker.

Secondaries, black, with rather narrow white median fascia, toothed in the center, and not reaching the anal margin. Fringe, white.

Beneath, primaries largely whitish, with a streak from base almost to center of wing, and a large irregular blotch on apical margin, black, leaving the interior margin, a large portion of costa, and the apex, white. Along costa of both wings are a few reddish scales.

Expanse of wings, 0.80.

(Coll. Hy. Edwards, No. 203.) Placer Co., Cal.

Very nearly allied to *M. vacciniæ*, of which it may possibly be the other sex, but the differences of the under side are very striking, and while the base of the primaries is almost black in *vacciniæ*, in the present species it is dark fawn drab. The t. a. and t. p. lines are also much straighter than in the preceding species, and the median shade, with white fascia of secondaries, form a much more continuous line.

Melicleptria oregonica, n. sp. Hy. Edwards.

Anthœcia oregonica. Behr. MSS.

Head, thorax, and abdomen blackish, with gray hairs.

Primaries, chestnut brown, with golden reflection. As in *M. suetus*, Grote, the traces of the ordinary lines are lost. The base is dark, almost black, with the orbicular white and well defined. Beyond the middle and inclosing the reniform is a white band, bent inwardly, indistinct on costa, and not reaching to the internal margin. Sub-term., nearly straight, whitish.

Secondaries, blackish brown, with rather broad white median fascia, which is interrupted and almost divided near anal angle. Near exterior margin is also a white oblong spot. Fringe, whitish.

Beneath, primaries, white, with two nearly square spots in center, a line resting on the anterior one directed towards the base, and an almost regular sub-marginal band, brownish black. Secondaries, also white, a large kidney-shaped discal spot, and a marginal band reaching from base beyond anal angle, blackish.

Expanse of wings, 1.00 inch.

Coll. Dr. Behr. (Hy. Edwards, No. 4405.) Oregon. Colorado.

Heliothis Crotchii, n. sp. Hy. Edwards.

Fawn drab, with blackish brown markings. T. a., much toothed exteriorly near internal margin. Median shade, pale. Orbicular and reniform, both distinct, the latter surrounded by a brownish cloud. T. p., commencing very near the apex, bending inwardly about the middle, thence almost straight to internal margin. Beyond this is a brownish, dentate fascia, the dentations formed by the sub-term. line. Marginal line composed of black dots. The whole of the nervules are pale and distinct, giving a reticulated appearance to the surface.

Secondaries, dusky, whitish towards the base, with clouded discal dusky spot.

Beneath, yellowish drab; primaries, with large discal spot, and some dashes near the base, blackish brown; margin, wide, dusky, with sub-terminal line

pale. Fringes, drab, mottled with brownish. Secondaries, yellowish drab, with oblong discal spot, marginal and sub-marginal band, dusky. Thorax and abdomen, yellowish, with darker scales, both paler beneath.

Expanse of wings, 1.00 inch.

(Coll. Hy. Edwards, No. 5533.) San Diego. G. R. Crotch.

Axenus ochraceus, n. sp. Hy. Edwards.

Very similar to *A. arvalis*, Grote, but differing by a large basal dark space, and by the t. a. being bent angularly forward on the costa, not nearly straight as in the more common species. The median shade is gray and well defined, contrasting very strongly with the rest of the wing surface, which is ochreous brown. The whole of the lines are more strongly marked than in *arvalis*. The secondaries are blackish at the base, with a decided ochreous band, enclosing a narrow black fascia. Fringes, yellowish. Beneath, ochreous, with same markings as those of the upper side, but much fainter in tone. The posterior wings have almost an orange tint. Size of *arvalis*, of which, should it prove to be a variety, it is certainly a very extreme one.

San Diego. G. R. Crotch. (1 ♀. Coll. Hy. Edwards, No. 5535.)

Axenus amplus, n. sp. Hy. Edwards.

A very distinct and peculiar species, in which the wings are much broader and more rounded than in *arvalis*, and the lines and spots, with the exception of the sub-term., utterly obliterated. The color is greenish olive, with a few white scales sparsely scattered over the whole surface of primaries. Sub-term. line, whitish, much curved inwardly as it reaches the internal margin. Secondaries, with faint discal dot, a few scales, and an imperfect sub-marginal band, whitish. Fringes of both wings, white. Beneath, greenish drab, the primaries darkest, discal spot paler, large, reaching almost to costa. The secondaries have the base dusky, with three more or less perfect dusky fascia. The margins of both wings are black, and the fringes greenish drab.

Expanse of wings, 0.80 inch.

Lake Klamath. Oregon. Lord Walsingham, by whom a ♂ and ♀ were kindly added to my collection.

Annaphila arvalis, n. sp. Hy. Edwards.

Erastria arvalis. Behr. MSS.

Primaries, dull, grayish black, with all the lines exceedingly indistinct. The t. a. black, only slightly notched exteriorly, and edged posteriorly with whitish. Median shade, blackish, with a few whitish scales beyond. Reniform, almost lost in the gray scales surrounding it. Fringes, blackish, flecked with white.

Secondaries, pale yellow, with a dull black basal triangular patch, enclosing some yellow spaces. Margin, very narrow, even narrower than in *A. depicta*, Grote, and almost regular interiorly.

Beneath, both wings are yellow. Primaries, with broad black margin, widest at apex, and a narrow black transverse fascia, slightly bent outwardly

near anterior margin. Secondaries, with narrow marginal band as in the upper side, and narrow waved median band, behind which is a black discal spot.

Expanse of wings, ♂ 0.90. ♀ 1.05.

The largest of the species of the genus known to me.

Sierra Nevada, Cal. (♂ ♀. Coll. Dr. Behr.)

This is in some respects intermediate between *A. depicta*, Grote, and *A. danistica*, Grote, but differs from the former by its pale color, and by the absence of the discal spot of secondaries above, as well as by its larger size, and from the latter by the very different ornamentation of the under side.

Annaphila lithosina, n. sp. Hy. Edwards.

Erastria lithosina. Behr. MSS.

Primaries, dark fawn-color, with the markings all rich velvety black. Basal half-line more distinct than usual in this genus, and inclosing posteriorly a few white scales. T. a., very deeply dentate outwardly in the middle. Median shade, blackish, with a few bluish scales, especially around the orbicular, which is dark fawn-color. T. p., also dentate exteriorly, becoming almost straight as it reaches the margin. Outside the t. p. is a large, ovate, pure white spot, nearly reaching the costa. Reniform, obsolete. Beyond this, there is a bright fawn-colored shade, spreading from costa to internal margin, and joining the sub-term. line, which is blackish, terminating on costa in a white dash, and surrounded at apical angle by a few bluish scales.

Secondaries, bright orange; margin rather broad, deep black, widest towards costa, and deeply toothed internally. Basal space, blackish, with imperfect orange blotches, and a small black spot near anal angle.

Beneath, primaries, bright orange; transverse fascia, broad and nearly straight, black patch at the margin inclosing some yellow spots. Secondaries, margin as in the upper side, with a waved, broken fascia near the base. There is also a minute black spot resting on the costa.

Expanse of wings, 0.90 inch.

Sierra Nevada, Cal. (Coll. Dr. H. Behr.)

Dr. Behr informs me that this exquisite species is taken on the flowers of *Sambucus*. I saw a single specimen during the past summer at the Big Trees, Calaveras Co., which was hovering about the flowers of Dogwood (*Cornus Nuttallii*).

Annaphila amicula, n. sp. Hy. Edwards.

Primaries, blackish, with gray lustre. T. a., bi-dentate near the interior margin. Orbic., small, round, grayish. T. p., nearly straight, with only one tooth near the middle. Reniform, large, almost lost in the gray color which clothes the outer portion of the wing. Sub-term., velvety black, not reaching more than half way across the wing, divided on costa, and then inclosing some white scales. Marginal line, divided into a series of dots. Fringes, grayish.

Secondaries, bright orange, base black, extending along the anal margin, where the black line is slightly cut by an orange streak. Marginal band, rather narrow, but wider than in *A. depicta*, and only slightly notched interiorly. The discal spot is large, and a narrow black fascia, bent outwardly near the middle, extending across the wing.

Beneath, primaries, bright orange, shading into yellow on internal margin, a narrow transverse fascia, perfectly straight, and a large oblong discal spot, black. The margin broadly blackish, with yellow scales, widest at apex, and extending along costa, almost to the extremity of the transverse line. Secondaries, orange, with median transverse fascia, toothed near anal angle, and an oblong discal spot behind it, black. Between this and the marginal band are a few spots, suggesting the idea of a submarginal fascia. Margin, blackish, flecked with orange scales.

Expanse of wings, ♂ 0.60. ♀ 0.75.

San Mateo Co., Cal. (Coll. Hy. Edwards, No. 2587.)

Annaphila germana, n. sp. (?) Hy. Edwards.

Probably only a variety of the preceding. The primaries are exactly like those of *amicula*, except that all the lines and marks are more distinct, and the gray shade beyond the t. p. lighter in color and more strongly marked. The secondaries are bright orange, but have no median fascia, and the base is wholly black, while the marginal band is much wider than in the last species, and less deeply toothed interiorly. Beneath, there is little difference, except that the spots and lines are rather less strongly marked.

Expanse of wings, 0.75 inch.

Napa Co., Cal. (1 ♀. Coll. Hy. Edwards, No. 4379.)

Annaphila domina, n. sp. Hy. Edwards.

Primaries, darker than in any other known species, being deep black, with shadings of gray. All the lines, except the basal half, distinctly marked. T. a. almost straight, or with only a very small dentation in the middle. Orbic. and reniform, distinct, velvety black, the latter almost oblong. Across the median shade is a small patch of white scales, and a larger one outward of the t. p., which is arched on costa, dentate inwardly near the middle, and then continued straight to internal margin. Sub-term. almost wanting, the posterior margin of wings being dull slate-black, with no distinct markings. Fringes, also slate-black.

Secondaries, rich dark orange, with moderately wide border, only slightly notched internally, and extending all round the wing to the base, with an oblong discal spot, black. Fringe, black.

Beneath, the primaries are marked with the same system of coloration as those of *A. danistica*, but the orange is very much darker and richer in shade. The discal spots are three in number, each circled with orange. Beyond them is a transverse arcuate line joining another, extending along internal margin to base of wing. Margin, dusky black, apices broadly so. Secondaries, orange, with some scattered black scales along costa, and a black marginal band of moderate width extending to the base, speckled with white scales.

Discal spots small, almost linear. Tarsi and under side of abdomen with greenish and golden scales.

Expanse of wings, 0.75 inch.

San Mateo Co., Cal. (♀. Coll. Hy. Edwards, No. 5720.)

Annaphila superba, n. sp. Hy. Edwards.

Head, thorax, and abdomen, brownish black, sprinkled with gray scales.

Primaries, also blackish, with gray scales. The whole of the lines rather indistinct. Median shade, dark, with whitish scales. Orbic., obsolete. Reniform, blackish, surrounded by white ring. T. p., whitish, bent outwardly near the middle. Beyond this are some white scales, forming an imperfect fascia. Sub-term., black, not reaching internal angle, and between it and the margin are a few more white scales.

Secondaries, bright crimson red, margin of medium width, black, quite regular, and not toothed in any portion.

Beneath, both wings orange-red, shading into yellow, and surrounded by rather broad black margin. Primaries, with discal spot, and faint submedian fascia, black. Secondaries, with disçal spot, and faint transverse line near the base, also black. Fringes, above and below, grayish.

Expanse of wings, ♂ 0.55. ♀ 0.70 inch.

Marin and Napa Counties, Cal. (Coll. Hy. Edwards, No. 4381.)

A very beautiful species, not to be confounded with any other, the bright crimson of the lower wings (as rich as in those of *Catocala cara*) and the regular black margin serving to distinguish it.

LIST OF SPECIES DESCRIBED IN THIS PAPER.

Anarta Kelloggii, n. sp.	Sierra Nevada, Cal.
" *crocea*, n. sp	Dalles, Oregon.
Melicleptria venusta, n. sp	Klamath Lake, Oregon.
" *vacciniæ*, n. sp	Sierra Nevada, Cal.
" *fasciata*, n. sp	Placer County, Cal.
" *oregonica*, n. sp	Oregon—Colorado.
Heliothis Crotchii, n. sp	San Diego.
Axenus ochraceus, n. sp	San Diego.
" *amplus*, n. sp	Dalles, Oregon.
Annaphila nivalis, n. sp	Sierra Nevada, Cal.
" *lithosina*, n. sp	Sierra Nevada, Cal.
" *amicula*, n. sp	San Mateo County, Cal.
" *germana*, n. sp. (?)	Napa County, Cal.
" *domina*, n. sp	San Mateo County, Cal.
" *superba*, n. sp	Napa and Marin Counties, Cal.

Dr. Kellogg described a new plant, as follows:

Lilium Maritimum.

BY DR. A. KELLOGG.

Lilium maritimum. Kellogg.

Leaves alternate or rarely verticillate, chiefly clustered near the base, narrowly oblong-oblanceolate, subobtuse, narrowing into a short petiole, 3-nerved (intermediate or secondary nerves obscure), margins scarcely a little scabrulose, quite glabrous throughout, upper cauline successively diminishing to minute linear-lanceolate sessile leaves, barely ¼ of an inch. Peduncles elongated, terminal. Flowers few (1–3), somewhat nodding, short, or equilaterally obconic-campanulate; segments lanceolate, slightly revolute above the middle; genitals included, about equal; style short, straight.

Deep reddish orange-brown, inside dark purple spotted.

A small maritime lily found in the black, peaty, low meadows exposed to the bleak, foggy climate of the coast of California, in the vicinity of San Francisco. A lily not liable to be mistaken for *L. parvum*, K., or any depauperate form of *L. pardalinum*, K., as both of these have rhizomatic scaly bulbs, creeping, as it were, or spreading laterally into zigzag mats or masses, if the soil be rich or moisture favorable. Like the Oregon lily, this has isolated bulbs—both too hastily considered as varieties of *L. canadense*, like many others. This elastic species, for a lily hobby, is almost equal to any emergency; in the realm of speculative philosophy, this may have been truly the progenitor. From *L. canadense*, its nearest kin, it differs essentially in the genitals being included; a point not only of specific but generic importance. Flowers small, scarcely more than an inch in expansion, and of similar depth—giving it a truly equilateral obconic cavity, much more shortened and shallow-shaped. Style even shorter than the stamens. The perianth never pendent when in flower, but half erect, and looking outwards. Stem in general the smallest known—12 to 18 inches high, etc. I do not insist upon the absolute or relative form of the leaf being always narrower, although for the most part this is so; and very seldom do we see more than a single whorl, although cultivated remote from the coast, in light sandy soils; the leaves then may become broader, somewhat oblanceolate, acute, and sessile, but never pubescent along the veins. Salt margins of our sea-coast do certainly modify the forms of plants; yet, with all due allowance, the entire physiognomy is not so changed as we witness here.

In general, the bulb is pure white, strictly conic, scales closely pressed, 1 to 1½ inches in diameter; leaves 1 to 5 inches long, ¼ to ½ inch wide, rarely verticillate. Flowers May to August. Capsules long, narrow, not winged. The late lamented H. G. Bloomer, Botanical Curator, has long ago recorded his protest against this being considered a variety of *L. canadense*.

Dr. Gibbons made some verbal remarks on clouds.

Dr. C. F. Winslow, a former member of the Academy, being present communicated for record the following statement in order that investigations might be made upon the subject when opportunity might occur hereafter.

In 1853, in passing a barber's shop on Kearny Street, he saw a fragment of a large bone, appearing to be a portion of a tibia of some gigantic quadruped or reptile. He purchased it and still has it in possession, stored at Boston with his collections. He sent it to Professor Leidy several years after obtaining it, and the Professor pronounced it to belong to a gigantic sloth of an extinct and undetermined form. He sent it also to Professor Baird of the Smithsonian Institute, that a cast of it in plaster might be taken for preservation in case of loss of the original. This fragment was in an excellent state of preservation. The history of its discovery and location is this:

When workmen were engaged in digging a well, about the year 1852, where Dr. Frederick Zeile's Baths are now located, (that is, in the rear of 524–528 Pacific Street, San Francisco,) at the depth of about 23 feet they struck a hard whitish object, which on being thrown out was discovered to be the leg bone of some large animal. It was broken into several pieces, and the barber secured this fragment which he preserved, and for which he wanted a big price. The Doctor succeeded in getting it for three dollars. He then found one of the men who had been employed to dig the well, and was informed by him that the excavation went through one of the limbs of the skeleton, and that the whole of the rest of it was still embedded in the yellow silt through which they dug till they came to water. The workman judged the depth at which the skeleton laid to be about 23 feet below the surface.

When Dr. Zeile's brick building was put up, Doctor Winslow observed that the rear wall just embraced the well within its area; and he has always considered it possible to reach the skeleton without injury to the edifice, by careful excavation.

This gigantic fossil is probably entirely new to Science, and would be of great value to the collections of the Academy.

The Doctor hoped efforts might be made to explore this spot and obtain the bones. If the rest of the skeleton was as well preserved as the fragment he has, it could be easily and safely put together, and would be a priceless acquisition to the museum.

Regular Meeting, June 22, 1875.

Vice-President Gibbons in the Chair.

Twenty-four members present.

Donations to the Museum: Hon. F. Berton, Swiss Consul, presented a bronze medal cast in honor of Agassiz.

Dr. Wm. Gibbons, of Alameda, read a description of a new species of trout from Mendocino County, as follows:

Description of a New Species of Trout from Mendocino County.

[Typical specimen in the Collection of California Academy of Natural Sciences.]

BY W. P. GIBBONS, ALAMEDA.

Salmo mendocinensis. Gibbons.

Body stout; outline from the nape of the neck to the snout, somewhat incurved; dorsal outline, but slightly arched; tail, truncated; head, medium size; from the anterior margin of the dorsal to the snout, nine-tenths of an inch less than from the same point to the insertion of the tail. Teeth numerous, moderately stout, incurved, fifteen to twenty on each maxillary; nine stout incurved teeth on each pre-maxillary; two double teeth on the knob of the vomer, four on the shaft; palatal teeth recurved, thirteen on each side; five teeth on each edge of the tongue; about thirteen on each side of the lower maxillary. The end of the lower jaw projecting about half an inch beyond the obtusely rounded snout, which receives in a notch its knobbed extremity. Center of the eye on a line drawn from the extremity of the snout to the end of the lateral line.

Br. 12–13, D. 12, P. 13, V. 10, A. 13, C. [illegible].

Vertical line from the posterior extremity of the upper maxillary, four-tenths of an inch behind the posterior edge of the iris.

Adipose and anal opposite; ventral terminates under the middle of the dorsal. No spots on A., V., or P. Dorsal and adipose with oval dark spots.

From tip of snout to nape of neck, 4 inches.

Number of times contained in total length, 6.75.

From tip of snout to farthest point on free margin of operculum, 6 inches.

Number of times contained in total length, 4.5.

Total length, 27 inches.

From tip of snout—To anterior edge of iris, 2 inches.
" " To posterior edge of iris, 2.75 inches.
" " To extremity of superior maxillary, 2.63 inches.
" " To anterior base of dorsal, 10.75 inches.
" " To posterior base of dorsal, 14 inches.
" " To anterior base of adipose, 19.75 inches.
" " To base of tail along lateral line, 24.50 inches.
" " To base of tail, superior, 22.25 inches.
" " To base of tail, inferior, 22.75 inches.
" " To anterior base of anal, 17.50 inches.
" " To anterior base of ventral, 12.50 inches.

Greatest depth of body, 6.5 inches.

Color above lateral line when first taken from the water, cupreous iridescent, gradually blending to silver-white along the belly; the colors soon fade to gray.

The typical specimen from which this description is taken is a male of 7.5 ℔s. weight. The average weight of the fish is about 12 ℔s. The largest that has ever been caught weighed 28.5 ℔s.; the smallest that come to spawn, 4 ℔s. The color of the male is darker than that of the female. The male has very few spots, while the female is covered with them, except the belly: the spots along the sides are larger than the others. When first caught, the females are of a bright silver color; hence, some call them "silver salmon." The flesh of some is nearly white; of others, yellow or salmon-color. The males are deeper from back to belly, and thinner, than the females.

The spawning season commences usually the latter part of March, and lasts about a month. The hookbill goes from the first to the last of January; the Sacramento salmon, from the middle of January to the middle of February. Both invariably depart before this fish commences to spawn. They come up in pairs, and select different kinds of locations from the hookbill and the Sacramento salmon. They will take a fine ripple caused by a large rock or by tightly packed gravel, about which there is always some dead water. After brushing away the sediment, if any has accumulated, they lay their eggs, well distributed, seldom more than two or three clusters touching. They never cover their eggs with sand, as some fish do; nor do they dig holes, as the hookbill; nor select holes among large rocks, as the large salmon occasionally does. The period of incubation is not known. When hatched, the little fish must work down stream, as none are found in the rivers save those which are between half a pound and three pounds in weight. Like salmon, they must go to the sea and mature; though this voyage is not absolutely necessary, as some remain during the entire year, when the streams, drying up, prevent them from passing down; but, generally, they seem to depart before the water falls so low. Those caught in the fall, which have remained during the summer, are generally in as good condition as those which appear in the spring. They eat small fish and frogs, when in the spawning-beds. It seems to make no difference how large the fish may be, as to their stopping in fresh water. They are very sagacious about the time and place of depositing their spawn, when there are no large fish to prey upon them; nor do they lay them in such localities as the water may subside and leave them exposed.

Still they have numerous enemies, among which is a small trout which returns to the main streams in April, having either gone to smaller and clearer streams in winter, or hidden themselves; for I have never been able to find them in the main creeks during the winter. There is also a species of diver, mostly white, and larger than a wood-duck, which lives almost exclusively on the eggs during the season. This fish comes up all the streams that empty into the coast near this place.

I am indebted to Mr. Joseph H. Clarke, a corresponding member of the Academy, for the foregoing intelligent description of the character and habits of this trout. It has been a subject of careful observation with him for the past two or three years. The Academy is under furthur obligations to him for sending several specimens, which have formed the basis of the description of this species. It would afford me pleasure to recognize Mr. Clarke's contribution to science by giving his name to this fish; but there is already a *S. Clarkii*, described by Richardson.

Dr. Kellogg described a new species of Lily, as follows:

Lilium Lucidum.

BY DR. A. KELLOGG.

Lilium lucidum—Kellogg.—Leaves whorled, scattered below and above, lanceolate, or ovate lanceolate, very short petioled, or subsessile, pseudo-triplinerved or somewhat 3-nerved, smooth throughout, short peduncled. Flowers few (or 1—6), nodding, sepals sessile, lance-acute, strongly turbinate-revolute, thickened at the base, genitals exserted, about equal; style straight, thick, light translucent yellow-orange, the dark purple spots on the inside visible from without. June to August.

Bulb spheriod, or slightly depressed oblate-spheroid; scales thickened lanceolate, acute, strongly incurved and very closely appressed; whitish, with yellowish-greenish tinge, 1½—2 inches in diameter; isolated; perennial; stem more central, 2 to 3 feet high, quite glabrous throughout; shortish thick peduncles from axils of bractoid leaves; lower and larger leaves 1—1¼ inches wide, about 3—4 inches long, diminishing above; flowers 1½ inches expansion, 1 inch deep; style, ½—¾ inch long.

A lily from Oregon and Washington Territory, long known, but also considered by authorities as another variety of *L. Canadense*. Without recapitulating the isolated and peculiar perennial bulb, position of stem, form and color of flower, surface, equal genitals, etc., we take these to be constant characters. Indeed, the very revolute sessile sepals remind us more of *L. Superbum* than *Canadense*, while the smaller, closer flowers and thickened base are peculiar. These points were distinctly discussed and shown to the Academy about fifteen years ago, when this same painting, accompanied by specimens, was on exhibition; and our opinion then given as to its being a distinct species. Having no bulb in hand at the time to verify statements or complete the manuscript, it was held in abeyance, we believe, although the description was then written.

Judge Hastings read three papers on the following subjects: "On the Genuineness of Archæological specimens, including Ancient Coins;" "A Plan for the Construction of Levees for reclaiming land;" "San Francisco as a point for an Astronomical Observatory."

Amos Bowman read a paper on "The Geological Formation of California."

REGULAR MEETING, JULY 6TH, 1875.

President and Vice-Presidents being absent, R. E. C. Stearns was called to the Chair.

Owing to a misapprehension on account of the night of meeting, only six members were present, and the meeting adjourned without transacting any business.

REGULAR MEETING, JULY 19TH, 1875.

Vice-President Gibbons in the Chair.

Twenty-three members present.

Donations to the Museum: Duplicate fossils, "Types of Dana's exploring expedition to Australia and Japan." From Henry Edwards, specimens of *chœtiles crenita*, *spirifer glaber* and *Platychisma occulis* from Australia; also specimens from the miocene, Oregon, *cleobis grandis*, (N. S. Wales,) *Pleurotomaria Morrisiana*, (N. Z.), lignite from Astoria, Oregon; Crustacean from the Bay of San Francisco. From W. Sublette, *Chimœra Calliniensis*. From W. A. Woodward, galena ore from Searsville, San Mateo County. Quicksilver ore with garnets, Sonoma County, from

R. R. Craig. Samples of *Annatidæ* found floating in the Pacific by the donor, Dr. O. M. Wozencraft. Five birds from F. Gruber. *Fontinalis antipyritica* from Ireland, from Dr. R. K. Nuttall. Specimens of ore from R. R. Craig; also ores from O. P. Callaway.

The following paper by Henry Edwards was read by the Secretary:

Pacific Coast Lepidoptera.—No. 13. On the Earlier Stages of Vanessa Californica.

BY HENRY EDWARDS.

In a very interesting and valuable article by Dr. H. Behr, on the "Vanessidæ of California," published in the third volume of this Society's Proceedings, reference is made to the large swarms of *Vanessa Californica* observed some years ago in the neighborhood of San Francisco, and the simultaneous occurrence in various parts of the State of this insect, which, in ordinary years, cannot be otherwise regarded than as one of our rarer species. By a fortunate circumstance, I am enabled to add a few facts to the natural history of this butterfly, and at the same time to present a description of its earlier stages, which have been hitherto unrecorded. In an excursion up the cañon at the head of Richardson's Bay, at the base of Mount Tamalpais, on the 9th of May last, I observed, soon after leaving the open fields and passing into the more secluded portion of the gulch, myriads of caterpillars on every side, swarming on the ground and on every blade of grass. A further and closer search disclosed the fact that the bushes of *Ceanothus thyrsiflorus*, which here attain a large size, sometimes reaching as great a height as twelve or fifteen feet, were utterly stripped of their leaves, looking as if some pestilence had passed over them, and destroyed every vestige of their flowers and foliage. It was not difficult to divine that this denudation was owing to the multitudes of caterpillars which had made their home upon the plants, on which they were to be found in nearly all the stages from about the third moult to full grown larvæ. It is not too much to say that they could be counted in millions, for, in following the creek, which runs through the cañon, for upwards of a mile, I found the *ceanothus* growing abundantly, and the same circumstance of the immense numbers of the insect, and consequent destruction of the foliage of the plant, everywhere displayed themselves. The eggs of the parent insect appear to have been deposited in clusters, as I noticed upon the extremities of many of the branches small webs in which the cast skins of the young larvæ were very abundant, thus suggesting the idea that in their earlier stages the caterpillars are gregarious, not separating from their common home until about the period of the third moult. I found several of these skins sufficiently perfect to enable me to offer a fair comparison of the young larvæ with their appearance in the more advanced stage in which they came immediately under my observation. I sought carefully for any *Ichneumonidæ*

or other parasitic insects which might be present, imagining that so large an assemblage of larvæ would prove for them a certain attraction, but I did not succeed in taking a single specimen, nor as yet have any appeared among the caterpillars which I brought home with me. I have, however, observed in my breeding boxes four examples of a rather large dipterous parasite, probably of the genus *Tachina*. As, however, I carried away with me nearly ninety caterpillars, all of which passed successfully into the chrysalis state, this is but a very small proportion to be affected with parasitic enemies. Is it possible that this comparative immunity is owing to the sharp and formidable looking spines with which the caterpillars are furnished? Certain it is that the *Vanessæ* generally are more exempt from the attacks of Ichneumons than most other butterflies.

During the last summer, the young lupines in the Golden Gate Park were attacked by myriads of caterpillars, which at one time threatened their destruction, but the preservation of the small birds in and about the park kept down the swarm, and a succession of very cold winds, during the middle period of their growth, killed them off in thousands. I raised from the caterpillars, of which I took away with me upwards of a hundred, no less than eighty-five specimens of *Pyrameis Cardui* and *Pyrameis Huntera*, and not a single one among them was observed by me to be attacked by parasites. This, in conjunction with the facts noted above, with reference to *Vanessa Californica*, would seem to indicate that these insects enjoy a freedom from the assaults of their tiny foes, which is not granted to other members of their tribe. It may partially account for the vast swarms of the various species which periodically make their appearance in different parts of the world. But this is one of those singular occurrences connected with insect life, which are so difficult to explain satisfactorily. The cañon in which *Vanessa Californica* was found has been visited by J. Behrens and myself at least twice every season for the last six years, and though I have invariably sought most diligently for caterpillars, until now that of the present species has been utterly unknown to me.

It may with almost certainty be predicted that the coming fall will witness the same large swarms of this butterfly as those observed by Dr. Behr in 1856 and 1866, which dates will serve to indicate that the insect appears in such numbers about once in nine or ten years. The caterpillars collected by me fed voraciously, and changed into the chrysalis state from the eleventh to the twenty-fourth of the month, the transformation of all I had secured being complete by the latter date. In this condition, they were extremely restless, constantly keeping up a jerking motion, and knocking themselves against the lid and sides of the boxes in which they were placed, with such force as to be heard all over the house. On the 23d of May, my friend Samuel Williams, of the *Evening Bulletin*, was enjoying a picnic in the cañon mentioned above, when the attention of his party was drawn to a very singular noise in the bushes over their heads, the cause of which it was for a time difficult to discover. At last it was found to proceed from myriads of chrysalides, attached to the leafless stems of the *ceanothus*, which, by a constant motion of their bodies, gave a trembling to the branches of the shrub, and produced the singular and half weird noise referred to. The perfect insects began to appear on the 25th of May, and did not all emerge until the 6th of June, the average

time in the chrysalis state being about fourteen days. The young caterpillars are wholly jet black, with the spines shorter than they are towards maturity, and without any trace of the steel-blue, shining tubercles, which are so strong a characteristic of their more advanced stages.

After the third moult the following is the appearance of the caterpillar: Head, moderate, jet black, shiny, with two short branched spines on the crown, and a series of smaller ones on the sides in front. In the center of the head is a groove. Body, deep velvety black, each segment behind the head with five branched spines, at the base of which are bright, steel-blue tubercles. In the sunlight, these tubercles, from their highly polished surface, glisten almost like jewels. Between the spines, and particularly about the dorsal region, are a number of small white circular dots, from each of which springs a short whitish hair; and a rich black velvety line, sharply defined, extends from the base of the head to the anal segment. The latter is furnished with only two branched spines. Prolegs, black; abdominal legs, dirty yellow. Length, 1.00 inch.

Mature larva. There is no change except in size until the final moult, when the middle spine of each segment becomes bright yellow at the base, and the white spots at the base of the hairs larger and more numerous, giving the appearance of a yellow dorsal line. Length, 1.65 inch.

Chrysalis. General color, ashy gray, with bluish efflorescence; abdomen, fawn-color; head, with two rather sharp, well developed, blackish processes; thorax, mottled with brownish, with two angular spines near the junction of the wings; mesonotal process, rather large, brown, with sharply hooked spine directed backwards. On the sides of the thorax are four black points, the basal ones surrounded by a cream-white patch, which extends to the first abdominal segment. Wing covers, ashy, brown along the margins; basal abdominal segment, with two small, black spines, behind which are large cream-white patches. The remaining abdominal segments have each two black points surrounded with black patches, growing smaller and fainter towards the anal extremity. Spiracles, black, almost linear, with a series of black dots above and below. The anal segments are much arched, directed inwardly toward the exterior of the wings. Length, 0.65 inch. There is no trace of silver upon any part of the surface of the chrysalis.

As *Vanessa Californica* has been said by some authors to be identical with the European *polychloros*, I subjoin, for comparison, a brief description of the caterpillar and chrysalis of the latter species. It will at once be seen how widely separate the two are, in their earlier stages. *Vanessa polychloros, L.;* Caterpillar, bluish or brownish, with a lateral stripe of orange. The spines are slightly banded and yellowish. The larvæ feed on the willow and elm, and on some kinds of fruit trees, especially the cherry. *Encyclop. Method. Papillon.* 305. *Chrysalis,* flesh-colored, with golden spots near the neck.—*Ib.*

Since writing the above, yesterday (June 6th), in company with Mr. Behrens, I paid another visit to the cañon in which we had previously found the *Vanessa.* Contrary to my expectations, the insect was far from abundant, and at least 75 per cent. of those we found were crippled in the anterior wings, while dead specimens, which had never been able to take an extended flight, were scattered everywhere about our path. The females also seemed

to take refuge at the roots of the dried-up grass, abandoning themselves to death. Well developed specimens of both sexes flew rather rapidly, alighting very frequently, and settling on stems of trees and among decayed leaves closely resembling them in the color of the under side. They also invariably placed themselves upon the branches with the head downwards. The insects appeared to be confined to a very small area, as we did not meet with any specimens except in the immediate neighborhood of the spot in which the caterpillars were taken. The crippled state of most of the imagos may be owing to the extremely dry state of the weather during the past month, the want of moisture acting upon the wings of the insect during their last stage, and preventing their proper development.

S. C. Hastings read a paper on "Phenomenal Changes of Climate in Past Epochs."

Dr. Gibbons read an obituary notice of Marshall C. Hastings.

REGULAR MEETING, AUGUST 2, 1875.

Vice-President Edwards in the chair.

Thirty-five members present.

The following new members were elected: Dr. G. King, Dr. F. W. Godon, A. W. Crawford, Pembroke Murray, Wm. Eimbeck, Jas. L. King.

Donations to Museum: Fossil bone from Tanitos Creek, San Mateo County, California, W. S. Downing. Fossil shells from Pescadero, from Milo Hoadley. Fifteen species of *Unionidæ* from W. G. W. Harford. Textile plants from various localities, from Geo. W. Dent. Specimens of ores, from Joseph Potts, Coll Dean, R. H. Rogers, A. W. Von Schmidt and Geo. W. Dent. Woods, from A. W. Crawford.

Dr. Blake read the following paper:

On Roscoelite, or Vanadium Mica.

BY JAMES BLAKE, M. D.

At a meeting of the Academy in September of last year, I presented a specimen of a new mineral, under the name of Colomite, which I then considered to be a mica, containing a large percentage of chromium. I had, at that time, made no detailed analysis of the substance, and had merely arrived at the conclusion that it was a chrome mica, from some superficial blow-pipe tests, and from its reaction with acids; knowing, also, that chromium is not an uncommon ingredient in micas. Subsequent to my last communication on the subject, Dr. Ghent, of Philadelphia, to whom a specimen of the mineral had been sent, discovered that it contained vanadium, and on his informing me that such was the case, I sent him all the specimens of the mineral I possessed, so as to enable him to make a complete analysis of it.

I shall not now enter into its chemical composition, merely remarking that, as I before observed, it is evidently a potash mica, containing about twenty per cent. of vanadium, instead of chromium, as I had before stated. I expect Dr. Ghent will shortly publish his analysis of the mineral in the *American Journal of Sciences.*

The occurrence of a mineral containing so large a percentage of vanadium is interesting, as, up to the present time, vanadium has been found in but very few substances; it is, in fact, one of the rarest of the elements, and although it has lately been discovered in some volcanic rocks, yet it is present in such small quantities—not more than one part in ten thousand—that even its detection is difficult.*

The only chemist who has successfully investigated the properties of vanadium, is Professor Roscoe, of Manchester, and I propose to name the mineral, Roscoelite, as the most appropriate name I can give it.

As I stated on a former occasion, the mineral occurs, associated with quartz, in a vein in porphyritic rock, at Granite Creek, in Eldorado Co., in the lower hills of the Sierra. It has been extremely rich in gold, the mica carrying most of the gold. The substance is interesting. under a mineralogical point of view, as affording a unique instance of so large a proportion of a pentavalent element entering into the composition of a mica, and offers, perhaps, the most curious instance of the anomalies that present themselves in the chemical composition of this class of minerals.

*I think it probable that vanadium may occur in larger quantities in these rocks than is supposed, as I believe the methods employed for separating it are imperfect. I have mixed vanadium with basalt, and after treating it in the manner indicated for separating the substance, I obtained but about 65 per cent. of the quantity added. I have reason to believe that it forms compounds with the alumina, iron, and silica of the rocks which have not been at all investigated. Since the above was written, I find that Dr. Hall has found vanadium widely diffused in many rocks, generally associated with phosphorous, although I have been unable to detect the presence of phosphorous in the mica.

Dr. Blake related the results of some physiological experiments he had performed, to determine the molecular relations of Beryllium. Neither the specific heat of the metal, or the vapor density of its chloride, had been ascertained, and chemists were undecided as to whether it was a trivalent or quadrivalent element. Its physiological reactions, when introduced directly into the blood, so closely resemble those of alumina, that there can be no doubt but that it belongs to the same isomorphous group, and that it is therefore quadrivalent. There is also a close relation between the intensity of the physiological action of the compounds of these two metals and their atomic weights. In a series of experiments, conducted expressly to determine this point, the quantities of Be_2O_3, under the form of sulphate, required to kill 2,270 grammes of rabbit, when injected into the veins in divided doses, were .059, .061, .050 grm; and of Al_2O_3, injected under the same conditions, were .021, .023, .022 grm. The smallest quantity required to arrest the vital reactions, when introduced in one dose, was of Be_2O_3, .038 grm; of Al_2O_3, .016 grm; showing a marked increase in the physiological action of these substances with the increase of their atomic weights. This, I believe, is the first time that physiological reactions have been used to throw light on the chemical properties of a substance. Should, however, the carbon compounds follow the same laws in their physiological reactions as the inorganic elements, living matter must offer a valuable reagent in their investigation. The recent experiments of Messrs. McKendrie and Dewar, published in the twenty-third volume of the Proceedings of the Royal Society, certainly indicate that such may be the case, as in experimenting with the compounds of the Chinaline and Pyridine groups, it was found that the physiological action became stronger in going from the lower to the higher members of the series. They also observed that, in the Pyridine group, where the base became doubled by condensation, not only was the physiological action more intense, but its character was completely altered, agreeing with the salts of iron, with which analogous changes take place, both in the character and intensity of their physiological action, when the molecule is doubled in the change from the ferrous to the ferric salts. [See "Journal of Anatomy and Physiology,' vol. 3, p. 24.]

Dr. Behr described a new weed from Lower California.

A paper by W. N. Lockington was read as follows:

List of Echinidæ now in the Collection of the California Academy of Natural Sciences, May, 1875.

BY W. N. LOCKINGTON.

Suborder DESMOSTICHA.

This suborder includes the regular sea-urchins, that is, those in which the poriferous zones are continuous from mouth to apex, both of which are central, the apex with ocular, genital, and anal plates.

Family CIDARIDÆ.

Interambulacral areas very wide, with few coronal plates, each bearing a single primary perforate tubercle, surrounded by a large scrobicular circle. Actinal and abactinal systems large. Ambulacral areas very narrow, composed of numerous small plates, the pores in single pairs, and the median ambulacral spaces set with small flattened papillæ. Jaws not so complicated as in the *Echinidæ* and *Diadematidæ*. Teeth in shape of a gauge. Auricles made up of independent arches, and taking their origin from the interambulacral spaces. The spines are large and solid.

CIDARIS.

1. *C. Thouarsii*. Valenciennes. Panama. Gulf of California.

Two large specimens from the latter locality, presented by D. E. Hungerford. This species attains a diameter of about two inches.

2. *C. metularia*, Blainville. Red Sea. Mauritius. East Indies. Sandwich Islands. Feejee Islands.

The specimens in the museum are from A. Garrett, and were collected in the Sandwich Islands. This is a very small species, the largest specimen not exceeding three-quarters of an inch in diameter.

Family ARBACIADÆ.

This small family contains *Echini* without secondary and miliary tubercles; with the pores in single pairs; jaws somewhat resembling those of the *Cidaridæ*, and the auricles disconnected. The spines are solid, but thinner than those of the *Cidaridæ*, and the anal system consists only of four large plates.

ARBACIA.

3. *A. stellata*, Gray. Gulf of California. Panama.

Family DIADEMATIDÆ.

Test thin, ambulacra narrow. Spines long, hollow, verticillate or transversely striated; tubercles of ambulacral and interambulacral areas similar. Auricles not forming connected arcs. Pores in arcs composed of three pairs.

DIADEMA.

4. *D. Mexicanum*. Acapulco. Cape St. Lucas.

5. *D. setosum*, Gray. Cape Verde Islands. Japan. Sandwich Islands. Feejee Islands.

A single specimen from the Bonin Islands, presented by W. J. Fisher.

ECHINOTHRIX.

6. *E. calamaris*, A. Agassiz. East India Islands. Society Islands. Philippines.

A single fine specimen, presented by W. J. Fisher, naturalist of the "Tuscarora," and dredged from a depth of ten fathoms, off the Bonin Islands. When first brought in, there was observable a singular swelling at the apex, which led me to suspect there might be a parasitic crustacean within; a supposition which was afterwards verified by the extraction of a fine specimen of a new species of the family *Pinnotheridæ*, measuring fully 1½ in. across the legs. The family *Pinnotheridæ* are all parasitic, inhabiting the mantle of oysters, mussels, *Haliotis*, and other mollusks, and also, as in this instance, the extremity of the digestive canal of certain *Echini*.

Family ECHINOMETRADÆ.

This family contains many genera and species, all of them distinguished from the *Echinidæ* proper by having the pores arranged in arcs of more than three pairs. In many cases, the outline is a long oval, and the axis is oblique, that is, it does not coincide with the center of either ambulacral or interambulacral areas.

HETEROCENTROTAS.

7. *H. mammillatus*, Brandt. Zanzibar. Red Sea. East India Islands. Sandwich Islands. Feejee Islands. Gulf of California.

Alexander Agassiz, in his "Revision of the Echini," gives all these localities except the last; but we have in our collection unmistakable specimens of this fine species, brought to Prof. George Davidson from Cape St. Lucas.

The spines of *H. mammillatus* are very large, and vary in shape from that of a cricket-bat to that of a bayonet; and the test is very strong and thick.

8. *H. trigonarius*, Brandt. Mauritius. Java. Sandwich Islands. Feejee Islands.

Unfortunately, our only example of this species is a single denuded test, whereas of the foregoing we have three fine specimens; the arrangement of the tubercles in the abactinal part of the ambulacral region is, however, sufficient to establish its specific identity. The spines are usually triangular in section.

ECHINOMETRA.

9. *E. Van Brunti*, A. Ag. Peru. Panama. Gulf of California.

10. *E. lucunter*, Blainville. Zanzibar. Red Sea. East Indies. Japan. Sandwich and Feejee Islands.

Of this species we have three specimens, two of them from Japan, presented by W. J. Fisher.

11. *E. oblonga*, Blainville. Philippines. Seychelle Islands. Sandwich Islands.

STRONGYLOCENTROTUS.

12. *S. purpuratus*, A. Ag.

This species is abundant on this Coast between Puget Sound and San Francisco, but data are wanting to determine its range north and south of those points. It is eaten by the Italians. In color it is dark violet when alive, but the dried tests have a greenish tint.

13. *S. Franciscanus*, A. Ag.

This species is one of the largest of the Echinidæ, attaining a diameter of six inches across the test. It is found at various points upon the Pacific Coast, from Queen Charlotte's Island to San Diego, and A. Agassiz gives Formosa also as one of its localities.

14. *S. Mexicanus*, A. Ag.

Several specimens from the Gulf of California. The spines in this species are nearly as long as the diameter of the test; a peculiarity by which it may easily be distinguished from *S. purpuratus*.

15. *S. Drobachiensis*, A. Ag. North European Seas. North Pacific. N. E. Coast of North America.

This species is common to the more northern parts of both continents, and is found on both shores of this continent. It is, in fact, one of those animals which appear to have been driven in all directions from the pole, by the influence of increasing cold.

Our specimens, which are very fine and perfect, were presented by W. Jones, Esq., Surgeon U. S. N., and were dredged in 45 fathoms, about 6 miles off the shore of Marmot Island, Alaska, from a bottom of rock and sand.

16. *S. Intermedius*, A. Ag.

Two specimens in this collection appear to belong to this species, as they have the greenish spines and the small tubercles upon the anal system mentioned in the description by A. Agassiz; the locality, however, is different, as that author gives Japan, while these are from the Sandwich Islands.

Family ECHINIDÆ.

In this family the arcs of pores in the poriferous zone are never composed of more than three pairs. It is divided into two sub-families, the *Temnopleuridæ*, characterized by peculiar pits at the angles of the coronal plates, and the *Triplechinidæ*, which have short, straight arcs of three pairs of pores.

Sub-family TRIPLECHINIDÆ.

ECHINUS.

17. *E. Esculentus*, Linn. Norway. English Channel.

18. *E. Margaritaceus*, Lamk. Patagonia. California.

The specimen in this collection was dredged in 40 fathoms, at San Pedro, by W. J. Fisher.

19. *E. Norvegicus*. Norway. Mediterranean. Straits of Florida.

20. *E. Miliaris*. Norway. English Channel.

Genus TOXOPNEUSTES.

21. *T. Pileolus*, Agassiz. Panama. Gulf of California. Viti Island. Mauritius. East India Islands.

HIPPONOE.

22. *H. depressa*, A. Ag. Gulf of California.

23. *H. variegata*, A. Ag. Sandwich Islands. Japan. East India Island. Viti Island. Red Sea. Mozambique.

This species is smaller than *H. depressa*, from which it is easily distinguished by the small size of the tubercles, by the absence of tubercles in the interambulacral and median ambulacral spaces between the ambitus and the abactinal pole, and by the coloring (usually violet) of those spaces.

Sub-order CLYPEASTRIDÆ.

This sub-order, intermediate between the regular Echini and the *Petalostichæ*, contains Echinoids with very low, flat tests, petaloid ambulacra, and anal opening detached from the apical system, so as to give, as in the *Petalostichæ* or Spatangoids, an anterior and posterior extremity. They differ from the Spatangoids in the possession of jaws, which are, however, much simpler than in the regular Echini, and articulate upon the auricles of the test,

instead of being held in place by a system of muscles. On the lower or actinal surface ambulacral furrows, crowded with small pores, and arranged irregularly, take the place of ambulacra. The ambulacra of the upper or abactinal surface are broader than the interambulacra.

Family CLYPEASTRIDÆ.

Echini with supports connecting the upper and lower floors of the test, either as pillars, walls, or radiating partitions.

ECHINOCYAMUS.

24. *E. pusillus*, Gray. Norway. Mediterranean. Azores. Florida.

CLYPEASTER.

25. *C. rotundas*. Panama. Gulf of California. San Diego.

The fine specimen from the Gulf of California, in this collection, is of a dark violet tint, which is its color when alive.

26. *C. scutiformis*. Red Sea. Philippine Islands. Kingsmills. Japan.

It has been my good fortune to examine a large number of specimens from Japan and the Pacific islands, obtained by various persons, among them W. Garratt and W. J. Fisher. These specimens, which are $1\frac{3}{8}$ to above 4 inches in length, all evidently belong to one species, and that species a *Clypeaster*, and not an *Echinanthus*, since there are no double floors or double walls. As the small specimens agree exactly with the *C. scutiformis* of Samk., it is evident that the larger ones are the adults of that species.

The three specimens in the collection measure respectively $1\frac{3}{8}$, $2\frac{5}{16}$, and $3\frac{15}{16}$ inches in longitudinal diameter, and $1\frac{3}{16}$, $1\frac{7}{8}$, and $3\frac{1}{4}$ inches in transverse diameter; but I have seen specimens exceeding the largest of these.

Family LAGANIDÆ.

Floors of test connected by walls running parallel to the edge; interambulacra extremely narrow.

LAGANUM.

27. *L. depressum*, Sess. Kingsmills. Viti Island. Philippines. Australia. Zanzibar.

Two small specimens, one of which measures $1\frac{3}{4}$ inch longitudinal diameter by $1\frac{1}{2}$ inch transverse diameter, appear to be the young of this species. They are from the Kingsmills. The partitions, forming a narrow belt of three or four concentric walls near the edge of the test, agree with *Laganum* proper, not with *Peronella*.

Family SCUTELLIDÆ.

Test extremely flat, frequently perforated with cuts or lunules. Ambulacral furrows of under side more or less branching; tubercles and spines of upper and lower surfaces differing in size.

ECHINARACHNIUS.

28. *E. excentricus*, Val.

This is the common cake-urchin of the Pacific coast, found at all points from Sitka to Monterey, and also at Kamtschatka. It is extremely common at the mouth of San Francisco Bay, where it lives in great numbers on the bar, on a bottom of sand and a little mud, at a depth of from five to seven fathoms. The district inhabited by it extends for a length of four or five miles, and the width of a mile along the west and southwest part of the bar.

29. *E. mirabilis*, A. Ag.

This author gives Japan as the habitat of this species; but it is also found in Alaska, as we have two fine specimens from the Shumagin Islands, presented by W. H. Dall.

30. *E. parma*, Gray.

A. Agassiz gives New Jersey, Labrador, Vancouver Island, Kamtschatka, and Australia as habitats of this species. Our collection contains some specimens from Hakodadi, Japan, presented by W. J. Fisher.

MELLITA.

31. *M. longifissa*, Mich. Panama. Gulf of California.

ENCOPE.

32. *E. Californica*, Verrill. Panama. Mazatlan. Gulf of California.

One of our specimens is curiously deformed anteriorly and posteriorly, so that its transverse diameter greatly exceeds its longitudinal diameter. The abactinal side is jet-black, with a velvety surface of small spines; but the actinal side, where the spines are comparatively large, is of a mouse tint.

33. *E. grandis*. Gulf of California.

Of this massive species we have one fine specimen, presented by W. G. W. Harford.

Sub-order PETALOSTICHA.

These *Echini* have no teeth; the anal system is separate from the apical; the ambulacra are petaloid; the test is less flat than in the Clypeastroids; certain parts of the test and spines are greatly specialized; and the radiate form is accompanied with an evident bi-laterality.

Family CASSIDULIDÆ.

Petalosticha without plastrons or fascioles, on which the spines are arranged differently to the rest of the test. They approach the Clypeastroids in many respects, but have no teeth, and in form simulate the regular *Echini*,

ECHINONEUS.

34. *E. cyclostomus*, Seska. Australia. Kingsmills. Zanzibar.

35. *E. semilunaris*, Gmelin. Florida. East India Islands.

RHYNCHOPYGUS.

36. *R. Pacificus*, A. Ag. Gallipagos. Panama. Gulf of California.

Family SPATANGIDÆ.

The actinal part of the test occupied by a plastron, with bare ambulacral avenues defining its sides. Other plastrons formed by fascioles or bands of crowded miliary spines. The combinations of the plastrons and fascioles, with the shape of the test and petals, are the principal characters used in distinguishing the subfamilies and genera.

MARETIA.

37. *M. planulata*, Gray. Kingsmills. China. East Indies. Mauritius.

LONENIA.

38. *L. elongata*, Gray. Red Sea. Australia. Philippines.

BREYNIA.

39. *B. Australasiæ*. China. Australia. Japan.

A very fine specimen, 3⅞ inches long by 3⅛ inches broad, probably presented by W. Garrett, from the Sandwich or Society or Kingsmill Islands, as I found it in company with the crustacea collected by him in those localities.

ECHINOCARDIUM.

40. *E. cordatum*, Gray. Norway. Mediterranean. Britain. Brazil. Florida.

AGASSIZIA.

41. *A. scrobiculata*, Val. Panama. Gulf of California.

BRISSUS.

42. *B. carinatus*, Gray. Society, Sandwich, and Philippine Islands. East India. Mauritius.

ADDITIONAL SPECIES.

[Acquired since date of List.]

ARBACIADÆ.

Arbacia Dufresnii, Agassiz. Patagonia. Chili. Navigator Islands.
Locality of specimens in museum not known.

ECHINOMETRADÆ.

Colobocentrotus atratus, Brandt.

Specimens collected at the Paumotu Islands. Collected and presented by Capt. M. Turner. The species occurs also at Zanzibar, Java, and Sandwich Islands.

"Stimpson says that *C. atratus* is found at the Bouin Islands, adhering, simply by their suckers, to the perpendicular faces of rocks, exposed to the full fury of a Pacific Ocean swell. We must remember that the test of this genus forms, with its spines, a flat segment of a sphere, and that the close pavement of polygonal spines presents but little surface to the action of the water. The suckers of the actinal side are also very powerful and numerous." —*A. Agassiz*, "*Rev. Echini.*"

SCUTELLIDÆ.

Mellita testudinata, Klein.

Specimens from Galveston, Texas, presented by Mr. J. R. Scupham.

Dr. Blake called the attention of the Academy to investigations he is making in determining the molecular properties of minerals.

Regular Meeting, August 16, 1875.

President and Vice-Presidents being absent, Dr. Kellogg was called to the Chair.

Twenty-five members present.

Donations to the Museum: Silver ore from Nevada, from O. G. Leach. Thirteen specimens of ore, from Louis Lewis. Three specimens of ore, from L. Kaplan. Twenty specimens of Durangite, from Jos. T. Boyd. Five specimens of ore, from B. B. Minor. Four specimens of ore, from Geo. W. Dent; also from the same donor, nut gall, vegetable wax from the Andes, Orchilla from Mexico, Camel's hair from Calcutta, and Chinese envelopes. From A. J. Severance, specimens of rock, (core from Diamond Drill) from Oregon, California and Australia. Quicksilver ore from Santa Clara County, from A. K. Grimm. Silicified wood found 300 feet deep in Manzanita Mine, Nevada County, Cali-

fornia, from J. H. Wood. Fossil shells from Contra Costa County, and Cement Rock from same locality, donated by F. A. Walley. Silver ores from Jas. D. Stevenson.

A collection of forty-eight specimens of birds and mammals was presented by Professor Esmark, of the Royal University of Norway.

Dr. Kellogg spoke of his recent trip to Mendocino County. Among other things he had discovered there a true thorn—a California production.

Dr. Gibbons spoke of the remarkable climatic phenomena occurring last winter both here and in Europe.

Regular Meeting, September 6, 1875.

Vice-President Edwards in the chair.

Thirty-four members present.

Joseph O'Connor, J. P. Moore and G. H. Sanders were elected resident members.

Wm. Barber and E. Pander were proposed for membership.

Donations to the Museum: From A. W. Crawford, twenty-four species of Marine shells from California, Mexico and New Zealand; ten species of fresh-water shells from the eastern rivers of North America; twenty-one specimens of minerals, Arizona, California and Colorado. Mr. W. J. Fisher presented fifteen species of Marine and Land shells from Japan. Charles Kaeding donated eight Ornithological specimens. Mr. Blunt presented specimens of *Procyon Hernandzii*, *Taxidea Americana* and *Mephites occidentalis*. Mr. F. Gruber presented specimens of *Cardinalis igneus*, *Cyanospiza cyanea*, *Leucostictea tephroctes*, and Japan thrush. Mr. G. W. Dent donated Kouri gum from New Zealand, and crude India Rubber from Mexico. J. G. Riley

presented ore from Lake County. Cornelius Cole presented fibrous Asbestos from Maryland and from Elko County, Nevada.

Mr. Edwards spoke of his recent trip to Mt. Shasta, particularly with reference to the California "Pitcher Plant," (*Darlingtonia Californica*) found in great abundance in that locality, as follows:

Darlingtonia Californica. Torrey.

BY HENRY EDWARDS.

Some time since I promised to bring before the notice of the Academy the few facts I had observed with regard to the remarkable pitcher-plant (*Darlingtonia Californica*), and by adding to them as much information as I could collect with reference not only to this species, but also to those allied to it in habits and structure, it is my hope that more extended observations may yet be made by some of our members upon this very singular product of the vegetable kingdom.

The *Sarracceniaceæ*, the family to which our *Darlingtonia* belongs, is one of the smallest known to botanists, containing only three genera and eight species. Its place in classification has been assigned between *Nymphæaceæ*, the family of the water-lily, and *Papaveraceæ*, that containing the poppies. Its geographical distribution is remarkable, the whole of the species of the family being confined to the American continent. Thus, the genus *Sarracenia* contains six species, all of them natives of the Atlantic States, and only one of them having at all an extensive range, viz.: *Sarracenia purpurea*, of Linnæus, which is found from lat. 48 N. to Southern Florida, and westward as far as Ohio. The remaining species *S. pittacina*, Michx., *S. rubra*, Walt., *S. Drummondii*, Croome, *S. flava*, Lin., and *S. variolaris*, Michx., are all confined to the Southern States; the last named species being probably the most abundant, the others being only met with in favored localities. According to Dr. Asa Gray, the genus was named by Tournefort in honor of Dr. Sarrazin of Quebec, who early in the present century forwarded a description of the best known species, viz., *S. purpurea*, to Europe. Since the time of its discovery, plants have constantly been forwarded to England and to the Continent, and now very many of the greenhouses of the old world boast the possession of our pitcher flowers. Another genus, *Heliamphora*, of Bentham, contains but one species, *H. nutans*, Benth., a native of boggy places in British Guiana. It is remarkable in its family for the scape containing sometimes five or six nodding, blush-white, or rose-colored flowers; those of the other genera being solitary, and mostly dull yellow, or purplish in color. The remaining genus, *Darlingtonia*, is a native of this State, and the only one of the group found west of the Rocky Mountains. It contains but one species, *D. Californica*, the subject of our present consideration.

This remarkable plant was first described by the late Dr. Jno. Torrey from specimens forwarded to him by I. D. Brackenridge, Assistant Botanist to the

United States Surveying Expedition under Captain Wilkes, in 1842, who detected it growing in a marsh bordering a small tributary of the Upper Sacramento River, a few miles above Shasta Peak. Dr. Torrey, in his description, which will be found in the "Smithsonian Contribution to Knowledge, Vol. VI, 1853," says:

"Owing to the lateness of the season (it was October), the flowers had passed, and not even a single seed-vessel was found, but only the leaves and tall scapes, with the remains of a single capsule. The leaves, however, were so peculiar that no doubt was entertained of the plant being either a *Sarracenia*, or a near ally of that genus. Without the flowers, nothing further could be determined respecting it; but, from the bracteate scape and deeply parted lamina of the leaves, it seemed more than probable that it was distinct from *Sarracenia*. Long had I been hoping to receive the plant in a more complete state, when it was at last brought to me by my friend, D. G. W. Hulse, of New Orleans, who found it in flower in May, 1851, in the same region, and perhaps in the very spot in which it was discovered many years before by Mr. Brackenridge. The plant proves to be generically distinct from *Sarracenia*, as well as from the genus *Heliamphora* of Bentham; and I take great pleasure in dedicating it to my highly esteemed friend, Dr. Wm. Darlington, of West Chester, Pennsylvania, whose botanical works have contributed so largely to the scientific reputation of our country. The genus dedicated to the veteran botanist by De Candolle has been reduced to a section of *Desmanthus* by Bentham; and a California plant, from an imperfect specimen of which I had recently indicated a genus under that name, proves to be only a variety of *Styrax*."

It may be well to add to this interesting note of Dr. Torrey, that *Darlingtonia* differs generically from *Sarracenia* by the forked blade of the leaf, and by the shape of the stigma. The flower of the former is stated to be, "when fully expanded, about two inches in diameter; the calyx consists of five straw-colored acute sepals; the petals, of a like number, and pale in color, are narrowed and concave at the apex and broad below; the twelve to fifteen stamens are nearly hidden by the projecting ovary, which is top-shaped, slightly five-angled, and crowned by a short style, with a five-lobed stigma. The fruit is a five-celled capsule, with numerous seeds." I may here remark that, though the flower is said by Dr. Torrey to be nodding at the apex of the stalk, I did not find it so. In August last, when I first met with the plant in the neighborhood of Mount Shasta, the flowers had become perfectly erect, and most of the capsules had burst and discharged their seed. It struck me that this may be owing to a careful provision of nature, which afforded the plant, as it became erect in ripening, an opportunity of spreading its seeds to a greater distance than it could do if the flower continued in a drooping position. The seeds themselves are armed at their extremity with small bristles, which cause them to adhere to the *Sphagnum* and other bog plants of their habitat, and thus secure them against being washed away by any excess of water in the bogs in which the plant has its home. Interesting as the flower of *Darlingtonia* is, however, it yields in general attractiveness to the leaves, which are not only peculiar in form and structure, but perform one of those curious functions in nature, the object of which we can by no

means clearly understand, but which are none the less calculated to excite our wonder and admiration. Viewed from a little distance, a growth of *Darlingtonias* presents a most beautiful and singular appearance, having a fanciful resemblance to a number of yellow hooded snakes, with head erect, in the act of making the fatal spring. I may here observe incidentally, that *caput-serpentis* would have been an appropriate specific name. The bright yellow, and, in some cases, almost orange color of the hoods, also suggests a growth of giant orchids; and it is probably, in some degree, to this resemblance to a flower that the leaves are indebted for their faculty of entrapping insects, which is the most remarkable feature of the plant. The leaf, which is tubular for the whole length, sometimes reaches the height of three feet six inches, and has a peculiar twist in its stem, always bending in one direction, the course of this twist being marked on the edge of the leaf by a winged membrane, increasing in width from the base to its termination at the mouth of the pitcher. The apex of the leaf is a large, swollen, reticulated hood, sometimes, in well grown plants, as large as a man's fist, divided in front and above the opening into two lanceolate lobes, which are curved downwards, and are strongly marked with purplish veins, these colored veins being also continued on the inner surface of the tube for about one-third of its distance. For more than half its length the interior of the tube is smooth and marked with semi-transparent reticulations, but from that distance to the base it becomes more opaque; and it is furnished with a closely set series of fine, spinous hairs, laid thickly against the walls of the tube, and all pointing downwards. Examined under the microscope, these hairs present no trace of barbs or hooks, but are simply sharp points, hardened and toughened towards their extremity.

The whole of this structure appears to be admirably adapted for the singular habit of ensnaring insects, which is so wonderful a feature of the economy of *Darlingtonia* and its allies. The insects may easily be led to mistake the brightly colored hood for a flower, and wandering into its treacherous recesses, find a smooth passage at the top of the tube lighted by the reticulations of the leaves, and excreting a slight amount of viscous substance, slightly sweet, and of the consistence of honey. Passing along this passage, they at last reach the bottom, find on attempting to retrace their steps that escape is impossible, and their wings becoming useless by contact with the viscid discharge from the walls of the leaf, and the moisture secreted at the bottom of the tube, they sink to their death in large numbers, the tube sometimes being filled to the depth of from six to seven inches with the remains of insects in the various stages of decomposition.

I do not attempt to speak authoritatively upon the subject, but I am inclined to think that no process similar to that of digestion goes on within the plant, but that the fluid mass derived from the decay of the imprisoned insects descends through the tube into the earth, and is taken up by absorption, through the roots, thus acting as a kind of liquid manure. It is true that in the dead leaves the hard integuments of insects, such as the elytra of beetles, and the bodies of wasps and hornets are to be found undecayed, but this may be because the liquid secreted by the plant is not powerful enough to cause decomposition of these parts before the plant itself decays. An analysis of

the fluid found within the tube, and of the leaf itself, would be of service to decide this point, but the structure of the plant prevents the rejection of particles not needed for its subsistence, as is the case with *Drosera*, *Utricularia*, and *Dionea*. It would appear that all order of insects are lured to the fatal embrace of *Darlingtonia*, and it astonished me to find that I could recognize so many species among the remains I examined. I cut open and carefully studied the contents of about forty tubes in all, and found that I could distinguish no less than forty-three species of insects, which I am able to tabulate as follows:

Order—*Coleoptera:* Genera—*Platynus*, *Serica*, *Coccinella* (2), *Hippodamia;* number of species, five.

Order—*Hymenoptera:* Genera—*Apis*, *Vespa*, *Ichneumon;* number of species, three.

Order—*Orthoptera:* Genera—*Acrydium* (2), *Tettix* (?); number of species, three.

Order—*Neuroptera:* Genera—*Mantispa*, *Myrmeleo*, *Agrion;* number of species, three.

Order—*Diptera:* Genera—*Tipula*, *Musca*, *Tachina*, *Asilus;* number of species, twenty or more.

Order—*Lepidoptera:* Genera—*Colias*, *Agrotis*, *Botys;* number of species, three.

Order—*Hemiptera:* Genera—*Notonecta*, *Reduvins* (?) (2); number of species, four.

Order—*Arachinda:* Genera—(unknown); number of species, two.

It is probable that this list could have been very considerably increased, but I was sufficiently convinced that all the insect orders were represented in the seething pot of the *Darlingtonia's* kitchen. The greenest tubes—those which are of comparatively recent growth—seem to be less attractive to insects, and I have always found the largest quantity of remains in those which are richest and deepest in color. Across the opening of the hood a small spider, seemingly allied to the genus *Thomisus*, spins its web, as if aware of the attractive nature of the plant, and conscious that its own prey could be thus easily captured. I have also invariably found among the mass of decay some living larvæ of a small dipterous insect, probably one of the *Tipulidæ;* and I observe that a similar circumstance has been recorded by Dr. I. F. Mellichamp of Bluffton, North Carolina, with reference to the pitchers of *Sarracenia variolosa*. Dr. Mellichamp's paper is so interesting that I make no apology for transcribing the following: "The base of the tube of *S. variolosa* secretes a watery fluid, which is not sweet nor odorous, but which proves quickly fatal to all insects that fall into it. The whole inner surface is covered with very minute, closely appressed prickles, perfectly smooth, and pointed downwards, which render it impossible for an insect to ascend by walking, even when the leaf is laid nearly horizontal. Within the somewhat dilated rim of the tube, there is a band half an inch in width, dotted with a sweet secretion, attractive to insects, but not intoxicating. This also extends downwards to the edge of the outer wing to the very ground, thus alluring many creeping

insects, and especially ants, to the more dangerous feeding ground above, where once losing foothold, it is impossible to regain it. Even flies escape but rarely, the form of the tube and lid seeming to obstruct their flight. As the result, the tube becomes filled to the depth of some inches with a mass of decaying ants, flies, hornets and other insects.

Within this there is always found a white grub feeding upon the material thus gathered, perhaps the larva of a large fly which has been observed to stand upon the edge of the tube, and drop an egg into it. Soon after the full development of the leaf, the upper portion becomes brown and shrivelled, which is due to still another larva, the young of a small moth, which feeds upon the substance of the leaf, leaving only the outer epidermis, and works its way from above downward, until in due time it spins its cocoon, suspending it by silken threads just above the surface of the insect debris at the bottom. The whole forms a series of relationship, and an instance of contrivance and design, the full purport of which is by no means fully understood." It will thus be seen that the same general habit obtains through the whole family of *Sarraceniaceæ*, though in details there are to be found differences in some striking particulars. In the first place, it is more than probable that the liquid secreted in the base of the tubes of *Sarracenia* is pure water, deposited from the atmosphere,* but the shape of the hood in *Darlingtonia*, which totally covers the opening of the tube, suggests some other cause for the presence of moisture at its bottom. This liquid, which is *Sarracenia*, is said by Dr. Mellichamp to be inodorous, is in our California plant most disgusting in its smell, and after handling a number of specimens of the tubes, it is necessary to use some disinfectant like ammonia or chloride to remove the disagreeable ordor. The larva found among the debris of *Sarracenia*, though belonging undoubtedly to the dipterous order, is nevertheless of a totally different genus from that found in *Darlingtonia*, as the latter are very minute, almost microscopic in size, though it is possible that more than one species may yet be discovered. I should also state that I found no ants whatever in the tubes of *Californica*, though subsequent observations may yet add to our knowledge the fact of their presence among the victims. Nor can I find any trace of a lepidopterous larva, like that noted by Dr. Mellichamp, which was probably the early stage of some species of *Tortrix*. Careful and continued observation will, however, doubtless bring to light many new facts connected with the economy of this singular plant. The stems of *Darlingtonia* are generally marked with some ferruginous blotches, which are due to the presence of a small fungus, which has been examined by our fellow-member, Dr. Harkness, and by him pronounced to be a new species of *Trichobasis*. Dr. Harkness, while intending to publish the results of his observations, permits me to add that he proposes to name the species *Trichobasis Darlingtoniæ*. The Indians of the district around Mount Shasta are well acquainted with the fly-catching habit of *Darlingtonia*, but I regret to say that I could not discover their native name of the plant, nor could I learn that they ascribe to it any medicinal proper-

* NOTE—I have since been assured by Dr. Mellichamp that the liquid is by no means pure water, but an excretion of the plant itself. H. E.

ties. I was the more surprised at this, as I was aware that to *Sarracenia purpurea* is credited a large amount of virtue in cases of small-pox, a paper on its efficacy in this terrible disease having been contributed to *Land and Water* in 1871, by Captain Hardy of the Royal Artillery, who spent some time in Newfoundland, and who derived his knowledge of the value of the pitcher plant from the Indians of that region. The portion of the plant used is the root, which has been introduced into England, and is sold there at the high rate of 28 shillings per pound. I mention this fact as it is more than probable that our own species may possess some hidden virtue which may prove equally as valuable to mankind.

I may state that *Darlingtonia*, though certainly a local plant, is by no means rare in the districts in which it is found. The locality nearest to San Francisco in which it has been detected is in the foothills of the Sierra, about 10 miles from Nevada City. It is, however, most abundant in the region about Mount Shasta, where it may be found in at least thirty or forty places within a radius of fifteen or twenty miles. It grows in boggy spots on the sides of mountains, and particularly about those known to hunters as "deer licks," which are abundant along the banks of the Upper Sacramento and its tributary streams. Extreme altitude is not necessary to its growth, as it is found from 1,000 to 5,000 feet. Mr. Robinson, of the *Field* newspaper, who visited this country a few years ago, chiefly for the purpose of observing the plant in its native haunts, states that it is by no means difficult of cultivation, and that it is "best treated by being grown in a soil of peat or peat and chopped sphagnum, kept wet, not merely moist, the pots or pans to be placed on a wet bottom—frame or cool-house treatment being the best in winter, warm greenhouse or temperate stove in summer."

In concluding these imperfect remarks, perhaps I may be permitted to hope that they may be the means of directing more perfect attention to this remarkable plant, which must always be regarded as one of the many vegetable wonders of California.

Regular Meeting, September 20, 1875.

In the absence of the President and Vice-Presidents, Charles Wolcott Brooks was called to the Chair.

Fifty-two members present.

Donations to the Museum: From L. Higbee, Los Angeles, specimen from an artesian well 189 feet deep. From Henry Chapman, Fossil Shells—cretaceous—from Alameda County. From F. A. Walley, Fossil Shells found in sandstone in Marin

County. From C. C. Coleman, Ramie fiber. From C. D. Gibbes, fibrous Asbestos and Manganese. From Star & Mathison, Plumbago from Ceylon, Antimony from Nevada, and "Regulus" from San Francisco. From Charles Reed of San Mateo, Argentiferous Galena from Sacramento mine, San Mateo County, Gold ore from San Gregorio Creek, and Indian implements (stone) from Redwood City. From G. W. Dent, two Lizards from China as prepared for medicine by Chinese. From J. Daniels & Co., Scotch Granite. From Holmes & Dawson, Suisun Marble. From Fred. MaCrellish, Sulphur from Sulphur Banks, Humboldt County, Nevada.

Mr. Williamson read a paper on "Fish Culture."

T. J. Lowry read a paper describing a new method of determining positions in Hydrographic Surveying, as follows:

A New Method of Determining Positions of the Sounding-Boat—Application of the Two-Point Problem to Hydrographic Surveying.

BY T. J. LOWRY.

This is called the age of practice—the inventive age. And, undoubtedly, the prevailing tendency of the science of this age is synthetic. The problem it places before itself is not so much to discover isolated truths as to combine, to harmonize, to generalize, to utilize those already found out. Instead, then, of indulging in ineffectual wanderings in the labyrinths of analytics, let us pause for a moment in the field of synthetical geometry—where Euclid, Newton, and Bessell deigned to labor—and see if there are not "seed fallen by the wayside, among rocks and in stony places," which we may cause to yield profitably for the exact arts.

The increased traffic and travel on the rivers, bays, lakes, gulfs, and oceans, within the last half-century, have made the accurate mappings of the topography of these water-basins of the earth commercial, national necessities. The civilized nations of Europe have long felt and acted upon these demands of navigation and commerce; nor has the United States been left in arrears, for already has she executed a system of hydrography—even extending her researches into the Gulf Stream and kindred inter-ocean rivers—securing results which challenge at once the wonder and admiration of the scientific and navigating worlds.

The hydrographic chart is the lamp to the navigator's path over the intricate windings of the waters of the earth; the revealer of rocks, shoals, reefs, hidden beneath smiling seas, and therefore the secret to a safe navigation, and hence successful international commerce. Does it not, then, gentlemen, behoove us, as a scientific body, to make all possible improvements in the theory and practice of hydrography?

Hydrographic surveying was reduced to a real, a practical entity, by the discovery of the three-point problem, by Pothenot. This problem being wide in its application, accurate in its determinations, and yet most simple in its graphic solutions, has, from the first, stood the grand central truth of practical hydrography. But to fix a position by this problem is required, on three known points, two connected angles observed simultaneously. And with only two known signals in sight it utterly fails to fix a position. Now it is to remedy these defects, to fill up these gaps left open by the three-point problem, and thus enable the hydrographer to determine his position under a wider range of contingencies, that I propose the application of the two-point problem to hydrographic surveying.

In determining positions of the sounding boat, equal in accuracy, and second only in point of usefulness to the three-point problem, is the two-point problem, which, with its many varied phases and fewer known points, greatly increases the hydrographer's capability of ascertaining his position under every contingency. This problem determines any two points on an unknown range (or inter-range) if at each of these points are measured the (two) angles contained by this range and two known signals. The boat's path may either coincide with the range or inter-range (see Fig. 1), or cross it at two or more points (as shown in Fig. 2). In the first case we can fix the position of the boat at any two or more instants by "angling" at those instants on two known signals ("*A*" and "*B*"), and the undetermined range. When the boat only crosses the range at two or more points, its position can be fixed by this problem only at these points, and that, of course, by "angling" at the very instants of crossing the range. The better conditioned the quadrilateral, formed by the two known points and the two places of observation, the better will these places be determined; and will be wholly undetermined when the right line, through the places of observation, prolonged, traverses either one or both of the observed signals.

Where ranges are ready prepared for us—as when adjacent to cities with their flag-staffs, chimneys and spires, or where the country rises into highlands and mountain peaks back from the shore—the determination of a boat's position by this problem is alike easy and expeditious. And even where nature does not offer such ready prepared facilities, we can readily supply them, where the water is comparatively shallow, by dropping temporary spar buoys (a pole with rock to one end). One buoy will furnish a stern range, if we have another visible stationary object directly astern, or an inter-range if directly ahead. But if there is no such stationary object visible, then continue the line of soundings, and drop further along a second buoy, and at the same instant measure the angles contained by two known signals, and the first buoy, and from another point on the range of these buoys, catch the angles between this range and any two known signals, and the soundings are determined. By cutting on a third point on shore, from two or more of these determined positions of the boat, it can be fixed in position without visiting the shore or even stopping the sounding boat; other signals may thus readily be substituted for those swept away by storms, etc.

The buoys thus dropped being determined fixed points, may serve as signals for carrying a hydrographic triangulation further on out off shore. This

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FIG. II.

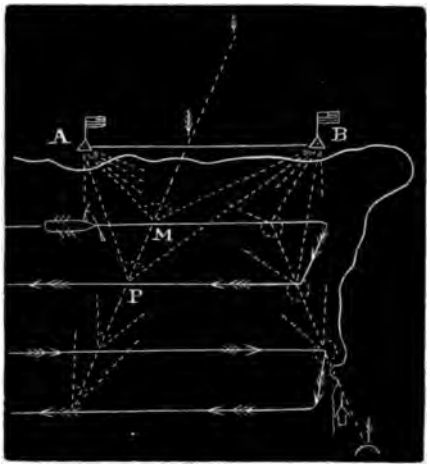
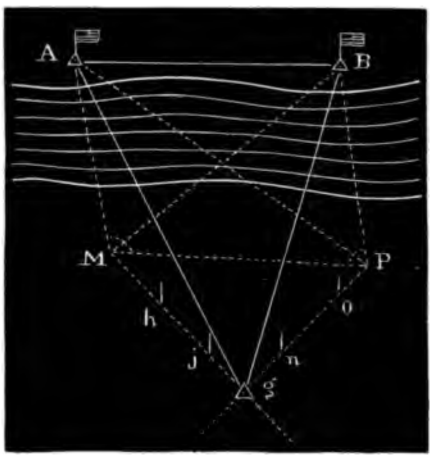


FIG. IV.



THE TWO-POINT PROBLEM. (LOWRY.)

(TO FACE PAGE 169.)

problem will thus prove most useful in the survey of off-shore shoals and reefs, and in the location of buoys, where only two signals are in sight. And it may, moreover, be found especially serviceable in the surveys of those large shallow bodies of water which abound along the Atlantic and Gulf coasts of the Southern States, where the low shores and hazy atmosphere render it extremely difficult to keep three signals in sight.

The geometrical construction of this problem is accomplished in the following obvious manner: On A B, in Fig. 3, describe segments containing respectively the angles A M B and A P B, draw the chord B y, to cut off segment, B A M y, containing the angle, B M y, and another chord A x, cutting off segment, A B P x, containing the angle, A P x. The points. x and y, will be in the same right line with M and P; join x y, which produce both ways till it cuts the circumferences in M and P, which will be the required places of observation.

The triogmetrical analysis furnishing the readiest means for computing this problem, is that known as the indirect. Thus, let any number, as 10 or 100, represent m p, in Fig. No. 1. Then in the triangle, A m p, are known the angles, A m p, $(=A$ M $P)$, and A p m $(=A$ P $M)$, with side, m p, from whence A m may be found. In the triangle, m p b, are known angles, m p b $(=M$ P $B)$, and b m p $(=B$ M $P)$, with m p, to find b m. Now, in the triangle, A m b, are known angle, A m b $(=A$ M $B)$, and the sides, A m and b m, from which A b may be found. And now, from the similarity of figures, $A\,b : A\,B :: m\,p : M\,P$, and by like proportions any other of the required sides may be found.

The two-point problem finds a ready graphic solution by laying off each set of observed angles on a separate piece of tracing paper, and shifting these two papers until the lines of sight traverse each its proper point, then prick the vertices of these angles on to the sheet, and they are (M and P) the required points of observation.

But a neater graphic solution, based upon very obvious geometrical considerations, is found in the three-arm protractor: with the angles measured at M (see Fig. 3) set off on the proper limbs of the protractor, cause its left and middle arms to traverse A and B, and draw a line along its right arm. Shift center of protractor to some point, as m—taking care to keep A and B bisected by left and middle arms—and draw another line along right arm and y, the point of intersection of these lines, will be a point in the right line through the places of observation, M and P. Now, set off the angles observed at P on the corresponding limbs of protractor, bisect A and B with the fiducial edges of the middle and right arms. Draw line along left arm; shift center of protractor to some point as p, and with middle and right arms still bisecting A and B, draw line along left arm, and x, the point of intersection of these two lines, will be a second point in right line through M and P. Draw an indefinite right line through x and y. Now, with the angles observed at P on the protractor, cause its middle and right arms to traverse A and B while the true edge of its left arm coincides with line through x and y; dot its center, and we have P, one of the places of observation; and, in like manner, find M, the other place of observation.

These are the solutions of the case of this problem where only two known signals are involved. There are, however, two other cases: First, where from one position of the boat signals *A* and *B* are visible, but from the other only *B* and *C* are seen; here the boat's positions are equally well determinate, and the geometrical construction and graphic solutions are the same as above given—but the trigonometrical analysis varies slightly (see Narrien's Geodesy). And in the second case, where first position of boat sees only signals *A* and *B*, and its second position only *C* and *D*, these positions are still determinate, and the graphic solutions and geometrical construction are identical with those already given, but the trigonometrical analysis is different, as shown by the writer on page 19, vol. 2, of *The Analyst.*

The two-point problem may, moreover, be found most serviceable in restoring lost stations. Suppose the case illustrated in Fig. No. 4—where (the surface mark of) station *G* is lost and its restoration is desired. Having an approximate idea of the position of the lost station, *G*, choose two such points, *M* and *P*, as make at once the quadrilateral, *A B P M*, and the triangles, *A M G*, *B P G* and *G M P*, "well conditioned." Then at *M* and *P* successively measure the angles *B M A*, *B M P*, *A P B* and *A P M*, and find—either by construction or computation, as above shown—the unknown sides and angles of the quadrilateral, *A B P M*. Now from the original triangulation are known the sides *G A* and *G B*, and angles *G A B*, and *G B A*; and the angle *G B P*=*P B A*—*G B A*. We hence have two sides, *G B* and *P B*, and included angle, *G B P*, to find *P G* and angle *B P G*, the distance and direction of the lost station, *G*, from the point, *P*. But if no linear measure is available, then mark the direction of *G* from the point, *P*, by range poles, *n o*, and shift the theodolite to *M*. Find angle, *A M G*, in like manner to that which found angle, *B P G*. Then cover *A* with telescope, turn it in azimuth equal to angle, *A M G*, and mark the direction of its line of sight with poles, *i h*. We then have marked out two ranges, *i h* and *o n*, intersecting at "the lost station," *G*.

And equally applicable when on land searching for a lost station with three signals in sight, is the maneuver so well understood in hydrography of taking from the sheet the angles subtended by the three signals at the lost station, setting them off on two one-angle, or one two-angle sextant, and shifting the position of the observer till the images of these signals coincide in his horizon glass, when he will be close on the "lost station."

Dr. Blake read the following:

On the Results of Glacial Action at the head of Johnson's Pass, in the Sierras.

BY JAMES BLAKE, M. D.

In a recent trip in the Sierras, at the head of the south fork of the American River, I met with some evidences of glacial action which I think are worthy of being recorded as furnishing some indications of the character of the climate during the middle part of the glacial epoch. The head of the valley

of the south fork of the American River terminates in Johnson's Pass, a gap in the western summit of the Sierras, about 7,500 feet above the level of the sea. The break in the mountains extends for about a mile and a quarter from north to south, and is nearly level. The upper part of the American Valley, for three or four miles, rises by a gentle slope up the pass, and is from half a mile to a mile wide, with a flat meadow bottom of mountain meal, bounded on each side by moraine blocks, lodged against the sides of the mountains. The head of the pass terminates by a pretty steep escarpment which forms a part of the western boundary of Lake Tahoe Valley, lying about 1,000 feet below. The south side of the American Valley, near the pass, is formed by a mountain about 9,000 feet high, the face of which, opposite the head of the pass, suddenly changes its direction, turning to the south to form the west wall of the southern termination of Lake Valley. To the north, the pass is separated from Echo Lake Valley by a vast bank of moraine matter, which formed at one time a lateral moraine of Echo Lake glacier, but which has been subsequently increased and gradually sloped off towards the valley by the bed of the glacier being forced up over it during the middle of the glacial epoch. As this Echo Lake glacier has evidently been an important element in causing the glacial action at the upper part of the American Valley, a short description of its old bed will be useful. The Echo Lake Valley is about four miles long, running in a direction southeast, northwest, and terminating towards the northern or upper end in a perfect amphitheater, surrounded by high peaks. The chord of this amphitheater or cirque measures probably two miles and a half, affording ample area for the formation of a vast glacier. The valley abuts to the southeast against the western wall of Lake valley at the north termination of the depression which forms Johnson's Pass. The bottom of the valley is now occupied by two lakes, one of which is a mile and three-quarters long, and a quarter of a mile broad, with a depth of water of 150 feet. The other, or upper lake, is smaller and not more than thirty-five feet deep. They are separated by a belt of rock a few yards broad, in which the granite presents a more schistose character. The rocks on the border of the lake show evident marks of glacial action to a height of 400 feet above its level, and moraine matter has been deposited fully 200 feet higher, so that the Echo Lake glacier must have been between seven and eight hundred feet thick. During the earlier part of the glacial epoch it was precipitated over an almost perpendicular cliff, a thousand feet high, into Lake Valley, and whilst pursuing this course it piled up a vast moraine on its southwest border, the upper end of which terminates at a height of about 300 feet above the level of the lake. This now forms the divide between Echo Lake and the American River Valley. The true nature of this embankment is well shown where it terminates above Lake Valley, and also at its upper part where it joins a spur of the mountain, but the greater portion of it has been so completely covered in by detritus, under the form of mountain meal, and the few rocks that appear on the surface are so completely rounded and polished that but for the appearances at the upper and lower ends, its true character as a lateral moraine would not be suspected.

As before stated, the lower end of Echo Lake Valley terminates at the edge of the escarpment forming a portion of the sides of Lake Valley, and it

was evidently over this escarpment that the glacier flowed during a long time; but as Lake Valley itself became filled with ice, and its glacier reached to the height of six or seven hundred feet above the side of the valley at Johnson's Pass, Echo Lake glacier could no longer escape into the valley, but was deflected with the vast ice stream from Lake Valley down the valley of the American River. In taking this new direction, the bed of the glacier was forced up over what had been before its lateral moraine, grinding off the angles of the rocks, and filling up the interstices with mountain meal, so that the moraine, particularly towards the American Valley, presents a gentle slope, with only an occasional boulder visible. The Echo Lake side of the embankment is much steeper, and a few feet below its crest has a ridge of moraine rocks, with perfectly sharp edges. This ridge is separated from the top of the embankment by a shallow depression, a few yards broad. These rocks had evidently been deposited on the ridge of mountain meal as lateral moraine, after the Lake Valley glacier had retreated below the level of the pass so that the Echo Lake glacier could resume its former course.

On the south side of the head of the pass, a large quantity of moraine matter has been deposited from the glacier coming in from the south end of Lake Valley. Until Lake Valley itself had been filled with ice up to the level of the pass, the moraine matter from this glacier would be deposited in the valley; but as soon as the ice reached the level of the pass, a large moraine was deposited, extending nearly half a mile across the head of the pass, and then bending to the west down the American Valley. This moraine, at the point where it leaves the mountain, is apparently about four hundred feet high, and a quarter of a mile thick at its base, and is composed of large masses of granite, with their edges quite sharp. Even a mile below the head of the pass, the moraine is 150 feet high and 400 feet thick, here forming the north wall of the basin of Andrean Lake, a small lake about 300 yards long and 250 broad, situated directly at the foot of the mountain, on the south side of the American Valley. The rocks at this part of the moraine are more or less rounded, and the interstices filled with the finer detritus. The middle of the valley, near its head, and for some distance down, is covered with a thick deposit of mountain meal, interspersed with large boulders, which have evidently been glaciated from the northeast. This has been opened to the depth of twenty feet without reaching the country rock. It is completely unstratified, and contains a few boulders, well rounded, but not very large, at least such was the case in a cut and tunnel made in the deposit towards the north side of the valley. In making the cut, a layer of gravel was found about eighteen inches from the surface; it was about two inches thick, and composed of rounded quartzose and other pebbles, and must have been derived from some disintegrated conglomerate beds. The only probable source of this thick deposit of finer detritus is from the bed of Echo Lakes, and the glaciated mountains to the northeast of the lower lake. It is found forming the bed of the American Valley for three or four miles from the summit of the pass, but beyond this point it gradually disappears, so that, at six miles from the summit, it was found extremely difficult to find any dirt to fill into the crevices between the rocks, when making a road through the valley.

Such is a general sketch of the results of glacial action at the head of American Valley—results which could only have been produced under totally different climatic conditions than a mere diminution of the mean annual temperature. It is evident that the formation of the large moraine across the head of the pass, from the glacier coming from the head of Lake Valley, could only have taken place when the surface of the mountain at the head of the pass was uncovered by snow, at least during a part of the year; or, in other words, at the time that the glacier in Lake Valley had attained a thickness of more than a thousand feet, there was no permanent glacier at the head of the pass. At present, the snow by the end of the winter is from ten to twenty feet deep at the head of the pass, and from four to eight feet deep in Lake Valley, and it has melted in the valley six to eight weeks before it disappears from the head of the pass. With a colder climate, in which, however, the relative temperature of the summer and winter should be the same as at present, it is evident that long before the Lake Valley glacier had attained a thickness of one thousand feet, a glacier some hundreds of feet thick must have occupied the head of the pass, so that the moraine matter brought down by the southern tributaries of Lake Valley glacier could not have been deposited there, but must have been carried down the valley of the American River as soon as the Lake Valley glacier was thick enough to force the ice stream in that direction. The most probable climatic conditions under which such a deposition of moraine matter as is found at the head of the American Valley could take place are, a colder winter with a very heavy snow-fall, and a hot summer, during which the snow would be removed from the surface, even at an elevation of 7,000 feet, when not fed by glaciers. The gradual filling up of Lake Valley by ice, was the result of the many glaciers coming into it on all sides, as has been shown by Prof. J. LeConte, and which had their origin in mountains from 1,500 to 2,000 feet above the level of the pass. That these ice streams were pouring into Lake Valley when the head of the American Valley was comparatively free from ice, is proved, also, by the formation of the large lateral moraine, from Echo Lake glacier, on the north side of the valley. Another fact that would indicate the rapid disappearance of ice at the upper part of the American Valley during the height of the glacial epoch is, the comparatively slight longitudinal extension of the glaciers down the American Valley. Although there is undoubted evidence that in Lake Valley, and at the head of Johnson's Pass, the ice attained a thickness of six hundred feet above the level of the pass, yet the larger part of the terminal moraine matter has been deposited within six or seven miles of the head of the pass, and at an elevation of only 1,000 feet below the top of the pass. Now, the rapid disappearance of this American Valley glacier, fed, as it was, by the Echo Lake glacier, and also by the vast ice stream from Lake Valley, would indicate that it must have been exposed to a much higher summer temperature than prevails at present. The topographical formation of the American Valley would also favor the melting of the ice, as the valley opens directly on the heated plains of the Sacramento, and thus affords a channel for the hot air of the plains during the summer, and for the moisture-

laden air from the warmer ocean that probably existed far on into the glacial epoch.*

Should the facts above stated admit of the interpretation I have given them, it is evident that they are inconsistent with the views of those who regard the glacial epoch as the result of mere geological changes in the distribution of land and water. That these changes may have played a subordinate part in intensifying the influence of cosmical causes is probable, just as the immense outflows of volcanic rocks, covering so many thousands of square miles of our continent to the depth of 1,800 to 2,000 feet, must have exerted a great influence on the warmer climate of the Miocene. In fact, as I have before stated to the Academy, I believe the heated term of the Miocene is much more easily referable to geological causes than is the cold of the glacial epoch.

Without wishing to attach too much importance to the facts above stated, I think the evidences of glacial action at the head of Johnson's Pass are inconsistent with any other hypothesis than that, far on in the glacial epoch, cold winters, with heavy snow-falls, alternated with very hot summers; and also that, at the same period, there was no permanent ice-covering on the surface at an elevation of 7,000 feet above the sea, at least in these latitudes. It is, I think, only in such climatic conditions that the vast moraines at the head of Johnson's Pass could have been formed, particularly the embankment moraine on the north side of Andrean Lake. This moraine could not have been formed by a glacier pushing its end out into water, as Professor LeCompte has shown was probably the case with similar moraines in Lake Valley and Mono Lake. The only conditions under which the moraine on the south side of the American Valley could have been formed was, that the surface on which it rests was not covered by ice at the time the Lake Valley glacier had reached the level of the head of the pass. The glacier from the head of Lake Valley, by far the largest entering the valley, then deposited a lateral moraine, stretching some distance across the head of the American Valley. As the ice accumulated in Lake Valley, and began to deflect the Echo Lake glacier to the west, the glacier from the south end of the valley was also forced in the same direction, depositing its moraine where the surface was still uncovered by ice, and thus laying the foundation on which moraine matter subsequently lodged, as the rapidly melting ice during the summer months exposed its surface, even after the rest of the valley was permanently covered with ice.

The accompanying rough plan shows the deposition of moraine matter at

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*It is probable that a glacier has extended some distance down the American Valley below the point indicated, but this I believe to have been later in the glacial epoch, when the glaciers at the head of the valley were possibly diminishing in thickness, and after the great ice sculpturing in the higher mountains had been effected. I believe that it was in the earlier stages, and during the height of the glacial epoch, that the principal ice sculpturing took place, caused by the sudden and great alternations of temperature. The moraine matter deposited by the retreating glaciers was evidently very slight, in comparison with that deposited whilst they were increasing.

the head of Johnson's Pass. I regret that, owing to an accident to my mountain barometer, I was unable to obtain exact hypsometrical measurements.

NOTE.—Since this paper was written, I have read Mr. Croll's work, *Climate and Time*, of which a large part is occupied in attempting to prove that during the glacial epoch the summers must have been colder than at present. As the grounds on which his argument is founded are more or less hypothetical, and his conclusions are, I think, inconsistent with the slight horizontal extension of the ancient glaciers, not only in the Sierras, but, as I have shown, also in the Puebla mountains, I must conclude that at least in this part of the earth's surface the glacial epoch was marked by cold winters with very heavy snowfall, and hot summers. The glacier coming from the south end of the Puebla range offers even a more marked example of slight horizontal extension than that at the head of the American Valley. This glacier had its origin in a valley six miles long and a mile broad, surrounded by peaks from 6,000 to 7,500 feet high, and which still retain snow on them during the whole year. At the height of the glacial epoch, this valley must have been filled by a vast glacier which escaped into the Puebla Valley, the latter valley being at an elevation of 4,600 feet above the sea; and yet under these circumstances the terminal moraine does not extend more than a mile and a quarter into the valley, although at its head, or near the foot of the mountain, it has probably a thickness of three hundred feet.

Mr. Lockington presented a communication drawing the attention of the Academy to the unhealthy condition of the building, suggesting remedies therefor, and that a committee be appointed to collect funds to improve the premises.

SPECIAL MEETING, SEPTEMBER 28, 1875.

Vice-President Edwards in the Chair.

Thirty-five members present.

By request of Mr. Edwards, General Colton, President of Board of Trustees, explained the object of the Special Meeting. He stated that the Board of Trustees had held a special meeting, at which Messrs. Felton and Hittel, Attorneys for Mr. Lick, were present. At this meeting Mr. Felton had read such parts of Mr. Lick's new deed, dated September 21, 1875, as were changed from the deeds of July 16, 1874, and September 16, 1875. The Trustees had informally agreed to the changes made by Mr. Lick. At the same meeting a deed was read, dated September 21, 1875, giving to the Academy, without any restrictions whatever, the property on Market Street, formerly deeded by

Mr. Lick to the Academy with certain restrictions, which are set forth in a deed dated October 14, 1873.

This was also informally accepted by the Trustees. Although the Trustees, under the law, and the Constitution of the Academy, are authorized to take charge of the property of the corporation and attend to its temporal affairs, the Board had thought it proper in a matter of this importance, to call a meeting of the Academy to endorse the action of the Trustees, or authorize them to act. It was explained that the new deed to the property on Market Street was eminently advantageous to the Society. Also that the new "Trust Deed" affected the Academy very slightly; and as all the other beneficiaries but one had signed, it only remained for the Academy to assent before sending it East for the signature of John H. Lick.

General Colton called on the Secretary to read the Resolution which the Board of Trustees proposed to adopt.

The Resolution was then read as follows:

Resolved, That the California Academy of Sciences do hereby accept the deed of James Lick, party of the first part, Richard S. Floyd, Faxon D. Atherton, Sr., Bernard D. Murphy, John H. Lick and John Nightingale, parties of the second part, and the California Academy of Sciences, the Society of California Pioneers, the Protestant Orphan Asylum, the Ladies' Protection and Relief Society, the Mechanics' Institute, and the Society for the Prevention of Cruelty to Animals, the City of San José, A. B. Forbes, J. B. Roberts, Ira P. Rankin, Robert McElroy, J. D. B. Stillman, Horace Davis, A. S. Hallidie, John Oscar Eldridge, and Lorenzo Sawyer, parties of the third part, which said deed is dated September 21st, 1875, and all the terms and conditions thereof, and do hereby release and discharge the said above-mentioned parties of the second part, in said deed named, from the performance of any of the duties imposed upon them by those certain deeds mentioned therein, dated respectively on the 16th day of July, 1874, and the 16th day of September, 1875, which are inconsistent with the terms and conditions of said first-mentioned deed.

Resolved, further, That David D. Colton (President) and Charles G. Yale (Secretary), of the Board of Trustees of this corporation, be and are hereby instructed to seal, sign, acknowledge, execute and deliver said first-mentioned deed in the name of this corporation, and with their names attached as such President and Secretary of the Board, and affix the corporate seal of this Academy thereto; and their acts in compliance with the above instructions are hereby ratified and confirmed as the act and deed of this corporation.

Resolved, further, That this corporation also accepts and receives that certain other deed from James Lick, party of the first part, to the California Academy of Sciences, party of the second part, dated September 21st, 1875.

By request of the presiding officer, Mr. Hittel, who was present with the new "Trust Deed" of James Lick, explained the changes which had been made in this, compared with the former one.

Mr. Hittel then read the deed to the property on Market Street, stating that it had been acknowledged by Mr. Lick. It is as follows:

JAMES LICK

TO

CALIFORNIA ACADEMY OF SCIENCES.

THIS INDENTURE, made and entered into this 21st day of September, 1875, between James Lick, of the City and County of San Francisco, State of California, party of the first part, and the "California Academy of Sciences," a corporation organized and existing under the laws of the State of California, and having its principal place of business at the said City and County of San Francisco, the party of the second part, witnesseth:

WHEREAS, Said party of the first party heretofore executed and delivered to the said party of the second part, a certain deed, dated on the fifteenth day of February, A. D. 1873; which said deed was duly recorded in the office of the County Recorder of the said City and County of San Francisco on the 20th day of February, A. D. 1873, in Liber six hundred and ninety-six (696) of Deeds, commencing at page three hundred and sixty-four (364), which said deed conveyed the following described piece or parcel of land in said City and County of San Francisco, State aforesaid, circumscribed by a line commencing at a point on the south-easterly line of Market Street distant one hundred and ninety-five feet south-westward from the south-westerly corner of Market and Fourth Streets, and running thence south-easterly and parallel with said Fourth Street, one hundred and ninety-five (195) feet; thence south-westerly at an angle of forty-five degrees to a point two hundred and seventy-five (275) feet from said south-easterly line of Market Street, which said last mentioned point constitutes the south-westerly corner of the hundred vara lot hereinafter mentioned; thence north-westerly and parallel with said Fourth Street, two hundred and seventy-five

(275) feet to said south-easterly line of Market Street; thence north-easterly and along said mentioned line of Market Street eighty (80) feet to the point of commencement. Said parcel of land being a portion of that certain lot of land laid down and commonly known upon the official map of said City of San Francisco, as one hundred vara lot number one hundred and twenty-six (126), with certain reservations and exceptions, and upon certain terms and conditions subsequent, all of which are fully expressed in said deed, reference to which said deed is hereby expressly made.

AND WHEREAS, Said party of the first part afterwards executed and delivered to the said party of the second part a certain other deed dated on the Third day of October, A. D. 1873, which said deed was duly recorded in the office of the County Recorder of the said City and County of San Francisco on the Fourteenth day of October, A. D. 1873, in Liber seven hundred and eighteen (718) of Deeds, commencing at page three hundred and eighty-seven (387), which said last mentioned deed granted, gave, conveyed and confirmed to said party of the second part, all the lands and premises described in said first mentioned deed and above described, with certain reservations and exceptions, and upon certain other terms and conditions subsequent, all of which are fully expressed in said last mentioned or second deed, reference to which is hereby expressly made.

NOW THEREFORE, In consideration of the premises and the respect and esteem said party of the first part has and bears to the said party of the second part, and the desire of the said party of the first part to further promote the prosperity of the party of the second part, and for the benefit of the Sciences in general, and in order to relieve the said party of the second part from all the terms and conditions subsequent, contained in said above mentioned deeds, or either of them, and from any and all terms, conditions and provisos, if any exist, the said party of the first part hath granted, given, confirmed, remised, released, and forever quit-claimed, and by these presents does grant, give, confirm, remise, release, and forever quit-claim unto the said party of the second part all the lands and premises described in said above mentioned deeds and hereinbefore described.

To have and to hold, all and singular, the premises hereby granted, given, confirmed, remised, released and quit-claimed

unto the said party of the second part and its successors, in fee simple, absolute, and without any conditions whatsoever.

In witness whereof the said party of the first part has hereunto set his hand and seal the day and year first herein above written.

(Signed,)

JAMES LICK. [L. S.]

[Recorded September 29th, 1875, at 20 minutes past 10 o'clock, in Liber 801 of Deeds, page 253.]

After the reading of the deed, the resolutions prepared by the Trustees and before read, was again read by the Secretary.

On motion of Dr. George Hewston, seconded by Charles Wolcott Brooks, the Resolution was adopted as read.

On motion, the Trustees were requested to convey the thanks of the Academy to Mr. Lick.

Regular Meeting, October 4th, 1875.

Second Vice-President in the Chair.

Forty members present.

Dr. G. F. Becker was proposed as a candidate for membership.

Donations to the Museum: Fourteen botanical specimens from Lower California, by G. W. Dunn. Tusks of Wild Boar from Santa Rosa Island, from W. G. Blunt. Rock from Choumagin Islands bearing specimen of *Terebratulina septentrionales*, dredged from forty fathoms by W. G. W. Harford. Fragments of ancient pottery, and one botanical specimen, from T. J. Butler, Prescott, Arizona. Insects from La Paz, from Dr. D. E. Hungerford. Hawaiian cotton, presented by C. C. Coleman. Silver ore from Arizona, by James Riley, Cerbat, Arizona. Two specimens of silver ore from Inyo County, from J. R. Frink. Sixty-eight specimens of minerals from various localities, from R. H. Sinton. Thirteen specimens of ore from White Pine, from T. H. Wells. Four specimens imitation marble on slate, and one specimen imitation porphyry on slate, from I. T. Milliken, San

Francicso. One specimen *Fontinalis antipyritica*, from R. K. Nuttall. Crustacean, from Dr. W. H. Jones, U. S. S. *Portsmouth*. Specimen of Manna found on Eucalyptus on State University grounds. Mr. Stearns said this was the first discovery of the kind on any Eucalyptus in California.

Dr. Blake read the following paper:

On Phylloxera.

BY JAMES BLAKE, M. D.

During the last week, I visited one of our extensive vineyards in Sonoma county, for the purpose of investigating, as far as a few hours would permit, the Phylloxera question, and as what I observed may be interesting to some, I will briefly state the results of my observations.

The proprietor of the vineyard was not certain, before I commenced my investigations, if any of his vines were affected. All he had observed was, that in separate patches about the vineyard the vines looked sickly. Some of them had died, and others were evidently dying; but, he stated, as he had noticed the same sort of thing for years, he did not attribute this to the new pest, although disease amongst the vines had never shown itself to the same amount as at present. In exposing the roots of one of the badly diseased vines, it was found to be covered by the insect. From two or three inches below the surface to as far down as the roots were traced (four feet), every crack and crevice in the outside bark of the root, was literally lined by Phylloxera. The vines in which this occurred were evidently in a dying condition. They had pushed out a few weakly shoots in the spring, which had not grown more than a few inches, and they had a few aborted bunches of grapes. They certainly would be dead next year. I noticed, in exposing the roots of the vine, that there were no superficial roots, at least, living. Some remains of dead roots were found on digging down, but nothing alive except the main roots. The lowest roots were not exposed, but from the escape of sap from the cut surfaces of the roots, it was evident that a certain amount of absorption was going on, and therefore that a large portion of the smaller rootlets must be uninjured. The roots of apparently a perfectly healthy vine were then examined. The plant had made quite a luxurious growth, some of the shoots being from six to eight feet long, and it had on it about fourteen pounds of grapes, which appeared to be ripening perfectly. The Phylloxera was found on the roots, but in much smaller numbers than in the other vine. Here they were confined to one or two cracks in the bark, and although pretty thick in these cracks near the surface, they were only met with in small patches at a foot under ground. These roots were followed down to a depth of more than four feet, at which depth a patch of Phylloxera was found, which consisted of not more than a dozen insects. About six inches above this was another patch, containing a larger number of individuals, and about every six or eight inches up the surface patches of the insect were

found, the size of the patches becoming larger as they were found nearer the surface. They were confined exclusively to a single longitudinal crack in the bark, at least from where the roots divided, about two feet beneath the surface. As before stated, they were found in patches, no insects being seen in the spaces between the patches. It was evident the crack in the bark of the root had offered a route by which the insect was gradually making its way down on the root. The patches undoubtedly indicated the stages by which the insect proceeded downwards, one insect from above passing over the intervening space and establishing a new colony, from which pioneers again started out to descend still lower. From the few insects found in the lowest patch, it is probable that this portion of the root had but just been attacked, and that not more than one generation had been born there. On some small roots that were given off about a foot from the surface, I found but one insect, and that near the main root. The soil of the vineyard was a gray clay, containing a considerable quantity of sand. It was derived from the disintegration of volcanic sedimentary rocks, and as it had been well ploughed and harrowed, it was quite fine and dusty. Under these circumstances, it is quite certain that the insect would not reach the roots of the vine through cracks and holes in the ground, as it is stated to do in France. Here there can be no doubt but that the migrations of the insect took place down the cracks in the outer bark, which not only afforded it a road, but also enabled it to introduce its sucker into the softer cambium, from which it derives its nourishment, and which it could not have reached through the whole thickness of the bark.

The fact of the infection of an apparently healthy vine, offers a serious prospect for the future wine prospects of the State, as it is impossible to say to what extent the disease already exists. It is probable that its effects only become manifest after it has already existed on a vine perhaps for years, and I think it likely that it will be found far more widespread than is now anticipated. I have, however, taken measures to ascertain this point, and I trust these remarks may call the attention of our wine-growers to the subject, and lead them to look for the insect amongst their apparently healthy vines. My own opinion is, that when a vine has once been attacked by the insect, it is merely a question of time as to when it will be killed, and the facts above stated show how hopeless it is to expect to be able to eradicate it when once it is established. In order to do this, we should have to expose the roots of the plant, and apply our remedies below the lowest point where the insect has penetrated. This is simply impossible. The only chance I see for successfully meeting the disease is, to endeavor to prevent its attacking vines that are already healthy, and I think this can most likely be effected in a manner that may not involve too much expense. There are two considerations in the history of the insect, which lead me to hope that this may be done. In the first place, I believe that at least in loose, pliable soil, that is kept well cultivated, the insect can only find access to the roots by crawling down the cracks in the bark, or in the crevices that are generally found about the root at the surface of the ground. I think it probable that some application, such as tar or train oil, that might be distasteful to the insect, might prevent its crawling down the stem; and surrounding the stem for a few inches with fine,

sharp sand, would not leave any cracks by which it could find its way beneath the surface. Again, the same means would be available for preventing its spreading. It appears that the way it spreads from one locality to another is, that at certain seasons of the year some of the insects become possessed of wings. These then come to the surface and deposit their eggs on the leaves of the vine, being often carried to some distance by the winds, and by this means alone it would appear that the diseased area becomes enlarged. Now, the same plan that would prevent the insect from descending to the roots would also still more effectually prevent these winged Phylloxeras from coming to the surface and extending the area of the disease.

Unfortunately, notwithstanding the attention that has been given to the subject in Europe, the natural history of the insect has been but imperfectly elucidated. Perhaps when we come to know more about it other means may suggest themselves for controling its progress. Up to the present time no remedy has been found for it, and if I may be allowed to express an opinion on the subject, it is because it has been looked for, I believe, in the wrong direction, by endeavoring to destroy the insect on vines that are already diseased. For reasons above stated, I believe this to be impracticable. The plan, I think, that will be found available, will be to give up the vines already attacked, and endeavor to preserve those which are not already infected.

Dr. Blake read the following paper:

On the Reimer Grape.

BY JAMES BLAKE, M. D.

In a communication I read before the Academy, last November, I related some analyses that I had made of the juice of different varieties of grapes, more particularly in relation to their fitness for making wine. Amongst the grapes anaylzed was one called the Reimer, in connection with which the following facts may be interesting: The day after I had received the grapes, the proprietor of the vineyard called on me, and on looking over the grapes that his manager had sent me, told me when he saw that there was a sample of the Reimer amongst them, that there was no necessity for me to analyze that, as he had given orders to have all the vines of that variety to be destroyed. As I, however, had already commenced the analysis, I went on with it, and discovered that this grape was possessed of what I considered the best properties for wine making. On making this discovery, I requested the owner of the vineyard to have some wine made from the juice of this grape unmixed with any other. This was done, and although it is yet rather early to judge of the wine, yet it certainly, at present, promises to be the best California made wine I have yet tested, and orders have now been given to preserve every shoot and sprout of the Reimer for propagation. It is certainly the most desirable grape for California that I have yet met with. It is a very free grower, and I believe even a more prolific bearer than the Mission grape. It will be seen by the analysis, published in the last volume of the proceedings,

that it is the variety that contains the most malic acid, and the wine made from it has certainly developed more bouquet than any California made wine of the same age I have yet tasted, thus supporting the views I then advanced as to the influence of malic acid in developing the aroma of wine. It would seem that the vinicultural mind is at last waking up to the value of malic acid in wine-making, as a comparison of the prices paid for the different varieties of grape, with the data furnished by my analyses, will show:

	Malic acid per cent.	Price in Napa Valley per ton.
Zinfindel	0.60	$23.00
Reissling	0.57	18.00
Mission	0.11	10.00

Some sixteen years ago I endeavored to call the attention of our vine-growers to the necessity of propagating the more acid varieties of grape; but until within the last three or four years the greater part of our vineyards have been planted with the old Mission grape, undoubtedly the worst wine grape that can be selected.

Regular Meeting, October 18th, 1875.

Second Vice-President in the Chair.

Thirty-five members present.

Donations to the Museum: Three boxes of recent Sea water Shells, from R. H. Stretch. Photographs of relics from mounds, by Mr. Putnam. Mr. S. Jennings, through Dr. Gibbons, presented a pearl taken from a shell found at the Navigator Islands; also the shells. J. F. Jerome presented specimens of the Candle Nut from what the Sandwich Islanders call the "Ku Kui" tree. Black Marble from Alaska, from J. Daniels. Minerals and Fungus, from J. F. Jerome; also specimen of *Holothuria* used as food by the Chinese, shark's fins from China, Orchilla from Lower California. R. H. Sinton presented specimens of Copper ore. C. C. Parry donated specimen of mountain mahogany. Dr. A. Kellogg presented Trout from Inyo County, and seventeen specimens of Lichens. James Behrens presented specimens of radiated pyrites from Prussia.

Mr. C. D. Gibbes described the Candle Nut presented as the fruit of the *Aleurites triloba*, a tree of the family *Euphorbiaceæ*, grows 20 to 30 feet high; leaves tri-lobed; fruit about two inches in diameter; inner nut very hard shell, within which the meat is preserved for years; good to eat, but rather rich. The oil is easily expressed, and is sent to England for candle making. As a drying oil it ranks among the best. The Hawaiians string the kernels of the nuts on slender strips of bamboo and light them as candles; they burn with a peculiar but pleasant odor.

Dr. G. F. Becker read a paper on "Notes on a new feature of the Comstock Lode."

Dr. Hermann Behr made some remarks on "Phylloxera."

Henry Edwards read the following paper:

Pacific Coast Lepidoptera, No. 15.—Description of a new species of Catocala, from San Diego.

BY HENRY EDWARDS.

Catocala Augusta. n. sp. Hy. Edw.

Primaries. Ground color, very pale fawn-color, almost whitish. All the lines, particularly the sub-terminal, strong and distinct. Basal space, rather large, covered with black irrorations; basal half-line, almost obsolete. T. a., broad on costa, with a double tooth; thence slightly arcuate to a space beyond the middle, there forming a deep tooth, and bent again to the internal margin. This line is deep velvety black, edged anteriorly by a whitish shade. T. p., with a deep median double tooth, running obliquely from the median nerve to the internal margin, in a series of four teeth, and near the margin lost in a brownish shade. Reniform, large, distinct, whitish, edged with black. Sub-reniform, also, large and white, both with grayish shade posteriorly. Sub-terminal line, very strongly marked, with deep but even teeth, edged anteriorly with gray shade. Sub-terminal spots between the nervules, well defined, oblong, deep black. Fringes whitish, mottled with brown.

Secondaries. Rosy red, with yellowish tinge. Mesial band, moderate, almost straight inwardly until it reaches the middle, when it narrows and terminates about 2½ lines from abdominal margin. Marginal band also moderate, with two rather prominent teeth near the anal angle. Apices, broadly yellow. Emarginations and costa, also, with yellow shade. Fringes, white. Abdominal margin, clothed with fawn-colored hairs.

Underside. The black bands of primaries are very broad; the white ones very clear and distinct; the sub-basal one not reaching the interior margin; and the posterior one much wider on the costa than on the internal margin.

I.

II.

1. Bulimus pallidior, *Sby.*
2. Helix Veatchii, *Newc.*

Loaned by Smithsonian Institution.

Secondaries, two-thirds pale yellowish red, the mesial band narrower than on the upper side.

Expanse of wings, 3.30 inch.

Locality, San Diego, Cal. Mrs. Jas. Behrens.

The upper wings of this beautiful species recall the shade of the European *C. Fraxini*, but they are still paler in color, and with the lines even more distinctly marked. Its nearest ally is *C. Luciana*, Hy. Edw., from Colorado, but it differs from that species by its paler gray color, by the reniform and sub-reniform being whitish instead of black, by the lines being more deeply and regularly toothed, and by the extreme distinctness of the subterminal line. The color of the secondaries have also a more rosy tint than those of *Luciana*.

For this interesting addition to our insect fauna, we are indebted to Mrs. James Behrens, who has frequently added great rarities to her husband's collection, and to whom, through the medium of her given name, I have great delight in dedicating it. Mrs. Behrens took two specimens of this charming insect in August last, in the neighborhood of San Diego.

Mr. Stearns read the following paper:

On the Vitality of Certain Land Mollusks.

BY ROBT. E. C. STEARNS.

I submit for the inspection of the Academy a living specimen of *Bulimus pallidior*, Sby., one of nine given to me by Prof. Geo. Davidson, who collected them at San José del Cabo, Lower California, in March, 1873.

These snails were kept in a box undisturbed until June 23d, 1875, when I took them out, and, after examination, placed them in a glass jar with some chick-weed and other tender vegetable food, and a small quantity of tepid water, so as to make a warm humid atmosphere. This hospitable treatment induced them to wake up and move about after their long fast and sleep of *two years, two months and sixteen days*. Subsequently all died but this, which seems to be in pretty good health, though not very active.

It may be remembered that I mentioned before the Academy at a meeting in March, 1867, an instance of vitality in a snail (*Helix Veatchii*) from Cerros Island, even more remarkable, the latter having lived without food from 1859, the year when it was collected, to March, 1865, a period of *six years*.

The famous specimen in the British Museum which is cited in the books, *Helix desertorum*, had lived within a few days of four years, fastened to a tablet in one of the cases, when discovered to be alive.

Helix desertorum, as the specific name implies, is found in arid and sterile areas, in the continents of Africa and Asia, and has, as will be perceived, a wide distribution. From the former continent, I have specimens from Egypt, and it also ranges through Arabia in the latter.

The *Bulimus* from the main-land of the peninsula of Lower California, and

Helix Veatchii from Cerros or Cedros Island, off the coast on the ocean side of the same, come from within the same physical environment, being comparatively a limited distance apart.

The *Helix* belongs to an interesting and peculiar group, probably varieties of one species, which includes, at present, the following names: (1) *Helix areolata*, Sby., (2) *H. Veitchii*, Newc., (3) *H. pandoræ*, Fbs., and (4) *H. levis*, Pfr. Other forms geographically approximate may hereafter, on further investigation, be referred to the same lineage.

Of the above, (1) *H. areolata* was the first described, or I should say that this appears by the date to be the first name bestowed upon any member of the group. This species has been quoted from Oregon, and (4) *H. levis*, from the Columbia River, in both cases erroneously. The figures in "Land and Fresh Water Shells of North America,"* p. 177, are too elevated and globose for the typical *areolata*, but the larger figures faithfully represent *H. Veatchii*. Elevation and rotundity are insular characteristics in this group, and *areolata* is comparatively depressed. It is found in considerable numbers on the uplands around Magdalena Bay, which is on the outer or ocean shore of the peninsula, in latitude about 24° 40′ N.

Bulimus pallidior, which is pretty generally distributed through Lower California, from Cape St. Lucas northerly, has also erroneously been credited to San Diego in California proper. It is arboreal in its habits, at least during the winter season, and frequents the Copaiva trees. It has been said to inhabit South America, *which is probably incorrect*, and the locality "San Juan," mentioned in "L. and F. W. Shells," on p. 195, where a good figure of this species may be seen, should be *San Juanico*, which is on the *east* side of the peninsula, in latitude about 27° N.

The great importance of particularity in habitat will be at once perceived when I state that there are no less than *three* other localities on the west coast of America, *north* of the place cited, all of which are referred to in various scientific works which have come under my observation, as "San Juan," and there are perhaps as many more "San Juan's" *south* of that especially quoted herein, on the westerly coast of America, in the Central and South American States.

Attention is directed to the fact that the three species herein mentioned as exhibiting extraordinary vitality, belong to geographical areas, which receive only minimum rainfall, or which are, in simple language, nearly rainless regions.

Within such areas vegetation is exceedingly limited even in favorable seasons, and the presence and growth of the annual plants is, of course, dependent upon the rainfall; this last occurring infrequently makes the food supply of land mollusks and other phytophagous or vegetable-eating animals exceedingly precarious.

It is highly probable that a careful investigation in this direction will lead us to the conclusion that the land mollusks which inhabit arid areas have, through selection, adaptation and evolution, become especially fitted for the

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*Smithsonian Misc. Coll., No. 194.

contingencies of their habitat, and possess a greater degree of vitality or ability to live without food than related forms in what may be considered more favorable regions, and through and by reason of their long sleep or hibernation, *more properly estivation*, with its inactivity and consequent immunity from any waste or exhaustion of vital strength, are enabled to maintain their hold upon life when animals more highly organized would inevitably perish; and we are furnished with an illustration, in the instances cited, how nature works compensatively, when we institute a comparison with the opposite condition of activity, and the food required to sustain it.

Mr. Stearns called the attention of the Academy to certain fossil forms of the genus *Scalaria*, belonging to the sub-genus *Opalia*, discovered by Mr. Hemphill near San Diego.

Regular Meeting, November 1st, 1875.

Dr. Stout was called to the Chair in the absence of President and Vice-Presidents.

Twenty-eight members present.

Messrs. Charles W. Banks and G. F. Becker were elected resident members.

Donations to the Museum: From W. E. Burleigh from Island of St. George, Alaska, one full-grown male fur seal, one full-grown female fur seal, one fœtus (nearly full grown) of fur seal, one young sea lion two months old, head of walrus two years old. The fur seal are carefully collected specimens, complete and suitable for preservation.

Mr. Filhol was introduced by the Chairman and made a few remarks.

Dr. Gibbons made some verbal remarks on the difference in the rainstorms here and in the Eastern States.

Dr. Parry read a short paper in relation to botanical subjects in California.

Regular Meeting, November 15th, 1875.

Second Vice-President in the Chair.

Twenty members present.

Louis Nusbaumer was nominated for membership.

Donations to the Museum: A box of minerals containing 45 specimens, from Dr. E. S. Holden, Stockton. Specimen of Colymbres, presented through Dr. Harkness. Two birds from Navigator Islands, presented through Dr. Gibbons. Specimen of *Cebidichthys crista galli?* Ayres, from Captain Lawson, U. S. Coast Survey. Five specimens of fish from the lower waters of Kern River, from J. R. Scupham. Silicified wood from Sonoma County, by G. H. Saunders.

S. C. Hastings read a letter from Professor J. D. Whitney relative to the "Botany of California," to the effect that the work was nearly completed and ready for publication.

J. R. Scupham made some verbal remarks on the Toredo, presenting also a specimen of wood showing a curious instance where one of the rotifers had bored into the hole of its neighbor, the first instance where such an occurrence had been noticed.

A verbal discussion on the subject of Phylloxera was participated in by Dr. Behr, Dr. Blake, Dr. Kellogg and S. C. Hastings.

Regular Meeting, December 6th, 1875.

Second Vice-President in the Chair.

Thirty-five members.

T. W. Greene and Dr. Murphy were proposed for membership.

Donations to the Museum: Twenty-six specimens of Native Woods, presented by Mr. Joseph H. Clarke, Cahto, Mendocino County. Native Fishes, W. N. Lockington. Three specimens

of Fish and nine specimens of Crustaceans from Captain M. Turner. *Pinus aristata*, Dr. A. Kellogg. Acorns and branch of *Quercus fulvescens*, George W. Dunn. Specimen of *Artemia Utahensis*, from Dr. Harkness. Two Crustaceans and thirty-two specimens of *Myriapoda*, from Henry Edwards.

Dr. Kellogg explained that the donation of woods from Mr. Clarke was very valuable, all the specimens being in fine order and carefully prepared. A vote of thanks was passed to Mr. Clarke.

Dr. Harkness exhibited a map presented by General Stone, through Governor Purdy. The map shows the work done by American Engineers in Africa for the Egyptian Government, in the course of a survey.

Mr. W. N. Lockington read a description of the fish presented at the previous meeting.

Mr. Lockington also read a paper on Landscape Gardening, giving a list of the varieties of plants and shrubs adapted to California gardens, and containing suggestions as to the proper laying out of grounds.

Dr. J. G. Cooper presented the following:

New Facts relating to Californian Ornithology—No. 1.

BY J. G. COOPER, M. D.

The publication of the volume on Land Birds in the series of Reports of the Geological Survey of California brought down the history of that class of animals, for the most part, to 1870, although, having been written five years previously, many additional facts had accumulated, which could not be introduced into it, as only stereotyped proof-sheets were sent to me for correction. Some of these facts have been published by me in our Proceedings for 1868, Vol. IV, p. 3, as "Some recent additions to the Fauna of California," and more or less contributed to the "American Naturalist," or the following more recent works. The present remarks are intended to include only such later items as have never been published, or such opinions as differ from those of later authors. The following are the chief works relating to this subject that have appeared since 1865:

Birds of Ft. Whipple, Arizona, or Prodrome of Ornithology of Arizona Territory. By E. Coues, A. M., M. D., U. S. A. From Proc. Phila. Acad. Nat. Sciences, Jan. 1868.

The New and heretofore Unfigured Birds of North America. By D. G. Elliott. New York, 1869. Folio.

List of Birds of Alaska, with biographical notes. By Wm. H. Dall and H. Bannister. From the Proc. Chicago Acad. of Sciences, 1869, 4to. Also Mr. Dall's later articles in our Proceedings, on Alaskan birds.

A History of North American Birds, by S. F. Baird, T. M. Brewer, and R. Ridgway, Land Birds, in 3 vols., small 4to. Boston, 1874.

Birds of Western and Northwestern Mexico, from Collections of Col. A. J. Grayson, Capt. J. Xantus, and F. Bischoff. By G. N. Lawrence. From Memoirs of the Bost. Soc. of Nat. Hist., 1874. 4to.

Birds of the Northwest (the region of the Missouri R.) By E. Coues, M. D., U. S. A. Washington, 1874. 8vo.

Report on Ornithological Specimens collected in the Years 1871, 1872, and 1873, in Nevada, Utah, and Arizona. By Dr. H. C. Yarrow, H. W. Henshaw, and F. Bischoff. Washington, 1874. 8vo.

For convenience of reference, I give the pages of Ornithology of California, Vol. I, where the species are described.

TURDUS NANUS—The Dwarf Thrush, page 4. The notes given by me in the lower five lines of this page belong properly to the next species, as it is scarcely probable that any of this remain in the lower country of California, or even in the mountains in summer, unless above an elevation of 8,000 ft., as does its Rocky Mountain representative, var. *Auduboni* Baird. The song of that, and of the eastern race, var. "*Pallassi*" Cab., being described as resembling that of the Wood Thrush (*T. mustelinus*), with which I am familiar, I am sure that I never heard it in the Sierra Nevada up to 8,000 ft. alt., nor in the forests of Washington Territory, and that of var. *nanus* cannot be very different.*

It is the winter thrush of California, common from September to May.

As pointed out by me in the Amer. Naturalist, Jan. 1875, the name *nanus* has priority over *Pallassi*, but that of *guttatus* Pallas, 1811, will very probably become the specific appellation, being founded on a specimen from Kodiak, where this only is found. The description, however, is as applicable to young of *Myiadestes Townsendii*, and it was called a "*Muscicapa*." Bonaparte, in Comptes Rendus, 1854, thinks it is "very certainly the *T. Swainsoni*, but *may* not be the *T. Pallassi* of Cabanis." The size, however, does not agree with either of them, and perhaps for this reason Cabanis substituted *Pallassi* (founded on a Cuban specimen) for his *T. guttatus*, 1844, founded on Pallas's bird. The African *T. guttatus* Vigors, need cause no confusion, being doubtless a later named species.†

T. USTULATUS—Oregon Thrush, p. 5. This name is also prior to those of its eastern representatives. Townsend and Audubon confounded it with *T. fuscescens* ("*Wilsoni*"), which opinion was formerly endorsed by J. A. Allen; while Coues in 1872, and later authors, make it a variety of "*T. Swainsoni*" Cab. This, besides being named later, was described as from Siberia,

* The song described by Ridgway as of *T. ustulatus* in the Sierra Nevada, and like that of the Wood Thrush, was more probably that of *T. nanus*.

† *T. Aonalaschkæ* Gmel answers still better to the young of *T. nanus*, and could scarcely be a fringilline bird, as suggested by Baird, for Gmelin described the three spotted sparrows from there as "*Fringilla*," &c. *Melospiza Lincolnii* could scarcely be confounded with it. See farther on, under *Passerculus Sandwichensis*.

and a comparison of types seems needed to establish its identity. As, however, it is reported as straggling to Central Europe (as well as "*Pallassi*") it might much more easily reach Siberia from Alaska, where it appears to go farther north than var. *ustulatus*. The claim of "*T. brunneus*" Boddært, 1783, as being of this species, seems worthy of further examination.

I was misled in giving *T. nanus* as the common Summer Thrush of California, both by its having been given by all previous authors as the only small brown thrush found in the State (*ustulatus* being limited to the north), and by Heermann's positive assertion that it breeds in the oak groves near San Francisco, where I am now satisfied that only *ustulatus* spends the summer. I have since found the latter breeding as far south as lat. 35° at least, and probably to lat. 33°. There they are more olive than at the Columbia, approaching var. "*Swainsoni*," and are also smaller, as might be expected. This southern residence suggests that the Mississippi valley summer thrush of Audubon, and Wilson's Georgia birds, with similar nest and eggs, are the var. "*Swainsoni*," these authors not recognizing its distinctness from var. "*Pallassi*."

Our bird does not reach California from the south before April 15th, and leaves during September, thus supplementing the winter residence of *T. nanus* so fully, that they are easily mistaken for one species, more noisy and conspicuous in summer, their upper plumage being nearly the same in California.*

* The following measurements taken by me from fresh birds now preserved in the Smithsonian Institution, the State Museum of California, and my own collection, show that there is such a gradation in size between specimens of the two species collected in different latitudes, that no difference is noticeable in living birds at gunshot distance. The older specimens are recorded in P. R. Rep. IX, 213, 215, etc.

SPECIES.	LOCALITY.	DATE.	SEX.	LENGTH.	EXTENT.	WING.	CAT. NO.
T. ustulatus	Wash. Terr.....	May 31, 1854	† ♂?	8.00	12.25	3.75?	S. I. 8171....
"	" "	" " "	† ♀?	7.25	11.75	" ?	" 8172....
"	Saticoy, Cal ...	Sept. 7, 1873	♂	7.00	12.25	4.15	J. G. C. 1559.
"	" "	May 6, 1874	♂	7.00	11.40	3.75	" " a
T. nanus	St. Clara, Cal...	Nov. 18, 1855	‡ ?	7.00	10.50	3.30?	S. I. 4483....
"	" " ...	" " "	‡ ?	6.50	9.25	" ?	" 5943....
"	Ft. Mojave, Cal.	Jan. 25, 1861	♂	6 50	10.50	3.35	J. G. C. 64..
"	Saticoy, Cal	Nov. 7, 1873	♀	6.50	10.40	3.35	" " a.

† The sex of two is surmised on difference of size. The wings were not measured in these two. The wing of all the S. I. birds is given as above from Baird's average.

‡ The two first were young of the year.

It appears from Mr. Henshaw's measurements, in his report for 1873, that Arizona specimens of *T. nanus* average smaller, and he remarks on the contrast in size between them and var. *Audubonii*, as seen in Colorado, much larger than *T. ustulatus*.

Although the nest and eggs of this variety may have led to its correct affiliation with "*Swainsonii*," they are not always reliable in this genus, if Dr. Coues is right in stating that *T. fuscescens* sometimes lays spotted eggs, and builds either on the ground, in bushes, or in trees! (Birds of the Northwest, 1874). If a few more of the best marked distinctions become broken down by future observations, we may yet find that all the six races now divided into two or three species must be combined in one (a "*T. parvus* Seligmann, 1775"?).

T. Aliciæ? Baird—Alice's Thrush—In a note given by me in the "Nat. Hist. of Wash. Terr.," 1860. Zool. p. 171, I stated that I had seen two thrushes there in December and March, quite unlike *ustulatus*, which I then knew to be a summer visitor only. I compared them to Wilson's plate of "*solitarius*" (var. Swainsoni ?), and Swainson's of "*minor*" (var. Pallassi ?), but neither is at all likely to winter so far north. "Their color was a very dark brown, without a tint of olive, and the breast more thickly marked with spots of the same color, large and round." This agrees so nearly with Baird's description of the winter plumage of *Aliciæ* (then unknown), that they may be considered either to have been Alaskan specimens of that bird (not since seen in the U. S. in winter), or stragglers from Asia of a foreign species.

Harporhynchus redivivus—California Thrasher—p. 16. Eggs laid in a nest at Saticoy, Ventura Co., May 26th, hatched in 13 days. The length given in the text referred to, as 1.10, should be 1.20. The iris, colored yellow in many copies of the Cal. Ornith , is really brown, as in all the Californian species.

Polioptila cœrulea—Blue-Gray Flycatcher—p. 35. Can this be the "*Sylvicola cœrulea*," quoted by Townsend and Audubon from the Columbia River? That species is not now found west of long. 100°, while the above migrates north as far as the southern branches of the Columbia at least.

Lophophanes inornatus—Plain Crested Titmouse—p. 42. A curious relationship to *Chamæa* is shown in the tail-feathers of this species, which, under oblique light, show many dark bars above, as in that bird. The same character has recently been ascertained in *Melospiza*, and is quite apparent in some of var. *Heermanni*: also in species of *Peucæa*.

Salpinctes obsoletus—Rock-Wren—p. 64. The eggs described were so much more reddish than authentic examples from farther south described by others, that they may have belonged to the western House-Wren.

Thryothorus spilurus—Bewick's Wren—p. 69. The nest described was so different from that of *T. Bewickii*, that I was induced to consider the bird a distinct species; but as I find that northward it builds in hollow trees, houses, etc., I must suppose that it merely took some other bird's old nest, for want of such accommodations.

Troglodytes (ædon, var.) Parkmanni—Western House-Wren—p. 71. The references to "*T. Americanus* Aud." as from Oregon, by Audubon, Gambel, and Nuttall, were no doubt based on this variety, which is of about the same size, and was not distinguished until five years years later. Gambel, in re-

naming it *T. sylvestris*, had reference apparently to the name "Wood-Wren," given by Audubon to "*T. Americanus*." The latter author and Nuttall both considered it nearest to *T. hyemalis*, instead of *T. ædon*, from which confusion resulted; and Dr. Heermann, in quoting *T. Americanus* from California, as well as *T. ædon*, seems to have meant the American race of the "European Wren" (*T. Europæus* Cuv.), which is *T. hyemalis*. I have seen the latter recently just north of S. F. Bay, near the sea-level, in Sept., and down to lat. 35° from Nov. to March.

HELMINTHOPHAGA CELATA—Orange-crowned Warbler—p. 83—(var. *lutescens* Ridgw.). The nest and eggs described by Audubon, as quoted by me, must have belonged to some other bird. On May 25th, 1874, I found a nest near Haywood, Alameda Co., built on the ground among dead leaves, on a steep slope in the woods, very similar to that of the eastern variety found by Kennicott, and I shot the female for identification. The three eggs, probably a second brood, are clear white, densely spotted with brownish-red specks; size 0.50 by 0.60 inch. They were partly hatched, and probably a second brood.

DENDRŒCA AUDUBONII—Audubon's Warbler—p. 88. This species, having the greatest adaptability to different climates and foods, far outnumbers all the others. In winter I have seen them pecking at dough and other food thrown out of doors, besides fruit-skins, and green herbage.

DENDRŒCA CORONATA—Yellow-crowned Warbler—p. 89. A female of this species was killed in Oakland, Cal., in the winter of 1872-3, and I shot a very perfect male at Haywood, April 10th, 1875. As they winter as far north as New York, those of this coast may spend that season chiefly north of the U. S., or in the mountains. The nest and eggs, as quoted from Audubon's description, are considered by Dr. Brewer as belonging to some other bird—(See N. A. Birds, I. 228).

DENDRŒCA TOWNSENDI—Townsend's Warbler—p. 91. I saw one of this species at Haywood as early as Sept. 12th, 1875, in company with several of our summer warblers; so that it is probable that some of the species may breed not very far to the north. I saw no more until Dec. 5th.

GEOTHLYPIS TRICHAS—Yellow-Throat—p. 95. As I suspected, this species winters in great numbers in California, between lats 38° and 35°. I found a nest near Saticoy, Ventura Co., containing young on Apr. 22d, nearly as early as I before recorded them as migrating near San Diego. I have seen none in summer in the windy region around S. F. Bay, though a few winter there.

MYIODIOCTES PUSILLUS—Black-capped Warbler—p. 101—(var. *pileolatus* PALLAS). Although described by Baird in N. A. Birds, I. 319, as having a shorter wing and tail than the eastern var., the measurements and remarks in Pacific R. R. Rep. (Birds IX, p. 293) indicate the contrary, as well as larger size, according to the usual rule in west coast varieties.

As suggested by me, the arrival of this species in California is usually much earlier than observed in 1862, as I found them in 1873 near Saticoy, lat. 35°, on March 18th, the males migrating north in large numbers, and singing

much like *D. æstiva*. I no doubt mistook them for that species at Puget Sound in 1854, reaching there by Apr. 10th, as mentioned in Zoöl. of Wash. Terr., p. 182. I now find that they are a month earlier than that bird in California.

In May, 1875, I found a nest of this species built about four feet from the ground in a thicket of nettles at Haywood, Alameda Co. It was neatly formed of vegetable fibres and grass-leaves, 3½ inches wide, 2½ high, the inside 2½ wide and 1¼ deep. The three eggs measure 0.68 by 0.52 in., a little larger than those described by Dr. Brewer, and are white, with a scattered ring of brown specks near the large end. As this bird breeds so far north, and to the summits of the highest mountains where wooded, its frequency in so warm a locality in summer is surprising; but in 1873 I saw them feeding young at Saticoy, lat. 35°, which is, however, less inland and about as cool. The prevalence of the sea-breeze in summer makes the climate of the coast border within fifteen miles very much like that of the mountain summits at that season.

VIREOSYLVIA GILVA—Warbling Vireo—p. 116, (var. *Swainsoni* Baird). This bird seems to arrive much earlier than noticed in former years, as I found them at Haywood, Alameda County, near lat. 38°, by March 31st, 1875, while the date noticed in 1862 at San Diego, was April 10th, and at Santa Cruz, May 9th. Like several other birds, those that go inland appear to come earlier than those traveling along the coast; or, from being more common, their first arrival is more easily observed.

AMPELIS GARRULUS—Arctic Wax Wing—p. 127. The locality of my specimen, although doubted by some recent authors, may be verified by inspection of the original in the University of California, where it has been for a long time comparable with native specimens of *A. cedrorum*.

PINICOLA CANADENSIS—Pine Grosbeak—p. 151. A specimen which I shot in August, 1870, near the summit of the Pacific R. R. Pass, over the Sierra Nevada, was of a fine *orange-red* color, but beginning to moult. This plumage, which is not described by Baird, is stated by Nuttall to be the most adult condition of the species, the *carmine-red* characterizing younger birds. It may, however, be a fading change, like the yellow seen in caged birds of some other red species.

CHRYSOMITRIS TRISTIS—American Goldfinch—p. 167. The size of the eggs given by me is so much smaller than of Eastern specimens, that Dr. Brewer seems to think it wrong. I have, however, found them at Haywood even smaller, measuring only 0.60 by 0.50 inch, while I did not find either of the other species at Santa Cruz. Mr. W. A. Cooper thinks, however, that *C. Lawrencii* may breed there. At Saticoy I found eggs by April 25th, and at Haywood saw fledged young fed by the male on June 15th, so that they are not always so late in building on this coast as on the eastern. The eggs vary, as elsewhere, from white to pale bluish. This and the two next are called here, "Wild Canaries."

C. PSALTRIA—Arkansas Goldfinch—p. 168. This also, builds plentifully about Haywood, and the nests are not distinguishable, except in smaller size, from those of *C. tristis*, but built much earlier. Some were begun by March 1st, but finished slowly, only being worked upon when the day was warm. One was built in a rose-bush, not over four feet from the ground and close to the path, where we often looked at the female sitting on four eggs, which hatched in 12 days. The eggs here differ so much from those of *C. tristis*, that I doubt whether Dr. Brewer ever saw authentic specimens, they being much more bluish and less pointed in several nests which I compared, though one set was nearly white. I saw the first fledged young being fed by the parents, as early as April 30th. The males often breed in the same dull plumage as the females, and are all much less brightly colored in summer than in winter. Some of them at that season look almost black enough above for var. *Arizonæ*. Their flight is not undulating, like that of *C. tristis*, but with a weak fluttering motion of the wings; nor do they have a flying song, like that species. In March and April, these birds join with most of the other smaller birds in feeding on the caterpillars, which then swarm so thickly on the oaks as to destroy every one of the first growth of leaves. Though a new growth succeeds, there are some trees kept bare the whole summer, or stripped by successive broods of caterpillars.

C. LAWRENCII—Lawrence's Goldfinch—p. 171. I have recently seen this species near San Francisco in winter very rarely, and I did not see any at Santa Cruz or Monterey even in summer. They reach S. F. Bay in large numbers after March 20th, and scatter through the oak-groves in pairs, building early in April, chiefly in low branches of the live-oaks. Recently, some have begun to build in gardens, chiefly in cypress and other evergreen trees, where I found several nests. The eggs I find more elongated than those of *C. psaltria*, being 0.65 by 0.48 inch, and *pure white*. They were hatched in about 12 days, and in 12 more the young left the nest, following the parents with the same cry of "she-veet" as those of *C. tristis*, but as with *C. psaltria*, the flight of adults is without cry or undulations.

C. PINUS—Pine Goldfinch—p. 172. In 1874, I found that this bird is a summer resident in the cool foggy pine woods near Monterey, probably the only point suited for it at that season south of lat. 40° on this coast. I saw them there, building a nest in a high pine, in June. They come about San Francisco and Santa Cruz in small numbers in winter, and I shot one at Haywood as late as April 10th, 1875, where a few were with other species feeding on the caterpillars which then swarmed on the oaks. There are no coniferous forests about this place to attract them. They fly so much like *C. tristis* as to be easily mistaken for them in winter, but the only species that has the peculiar sharp note like "svéer" uttered by this species, is *C. Lawrencii*, which is also much hoarser in its song than the others.

PASSERCULUS SANDWICHENSIS—Alaska Sparrow—p. 180. Although late authors have made this a variety of *P. savanna*, it must claim the typical place by right of priority, while "*Emberiza arctica*" Latham 1790, may prove to be founded on the more eastern "*P. princeps*" Maynard 1874. "*E.*

chrysops" Pallas 1811, is also preferable to *savanna* Wilson, who seems to have given the name by mistake for the doubtful "*E. savanarum*" of Gmelin. If *Sandwichensis* is retained, there can be little doubt as to adopting also Gmelin's "*Turdus Aonalaschkæ*" founded on the "Aonalaska thrush," as this was called the "Sandwich or Aonalaska Bunting." The chances for confusion to have arisen in Gmelin's classification, are more than two to one in this case of the Bunting, above those likely to occur in his naming a bird *Turdus*. (See *T. nanus*).

P. (S. var.) ALAUDINUS—Skylark Sparrow—p. 181. The original type of this variety was from "California" (probably Bodega), and therefore represents the race so near var. *savanna*, which was first identified with it by Prof. Baird, and *not* the more inland, paler and smaller race, which he has so named in his latest work. As, however, all the races are admitted to intergrade together, it is perhaps not improper to give the name to the extreme variety, and to consider the California birds as linking it with var. *anthinus*, which seems to be his latest opinion. The measurements I gave from fresh specimens, as well as the new figures of heads given by him in N. A. Birds, show how uncertain are characters based on size to distinguish even the local races.

P. (S. var.) ANTHINUS—Titlark Sparrow—p. 183. Though Bonaparte's type was said to be from Kodiak I., Alaska, Prof. Baird has only recognized one young bird "of var. *Sandwichensis* approaching var. *anthinus*," from there, and none from the main-land of Alaska, referring all to var. *alaudinus*, including Dall's "*P. savanna*," which merely goes to show that the original type was not a very extreme form.

In 1872-3, in Ventura Co., I again observed the limitation of this variety to the salt marshes while an upland race frequented the dry, grassy hills along the cool sea beach, but not six miles inland, in summer. I found no nests, but shot a young bird newly fledged, of the latter variety, in July, which resembled closely the young of var. *savanna* described by Baird in his last work.

P. ROSTRATUS—Long-billed Sparrow—p. 184. The approach of this species to the genus *Ammodromus*, recognized by Cassin and confirmed by its habits, shows that *Passerculus* (as well as *Coturniculus* and *Centronyx*) is scarcely more than a division of that genus, though "*A. Samuelis*," p. 191, is now admitted to be a *Melospiza*. *P. rostratus* represents *A. maritimus* on this coast, while *P. anthinus* is the analogue of *A. caudacutus*. The young is thickly spotted on the breast like that of *A. maritimus*, and like the more southern variety *guttatus*. On May 26th, 1862, I found a nest among sand-hills close to the beach at San Pedro, built like that of *P. savanna*, and containing two eggs, whitish, thickly speckled nearly all over with brown. Though I did not see the bird, there was no other in the vicinity that was likely to have owned them except this species. Mr. Dunn has since found a nest at San Diego, two feet up in *Salicornia*, and with three such eggs, measuring 0.80 by 0.60.

CHONDESTES GRAMMACA—Lark Finch—p. 193. A few of this species winter

near San Francisco, where I saw them in the middle of January, 1875. The occurrence of this species farther east than formerly, some even to the Atlantic coast, seems to show that the denudation of the greater part of the Appalachian forests, is producing the effect of making that country so much better suited to the habits of birds of the great western plains, that they are gradually moving eastward. This migration, commenced by the Cliff Swallow in 1811, is now noticed in the Yellow-headed and Brewer's Blackbirds, the Magpie, Arkansas Flycatcher, and several others more fond of the forests, most of which could not have been overlooked by the old observers.

GUIRACA CŒRULEA—Blue Grosbeak—p. 230. In 1873, I saw the males of this species migrating north in small parties through Ventura Co. on April 17th, so that they come earlier along the coast than at Ft. Mojave. On the same day the allied *Cyanospiza* was migrating, as usual, in flocks, together with *Dendrœca æstiva*. In 1875, the two latter reached Haywood, Alameda Co., April 20th; but the Grosbeak seeks a more inland route toward the north. The arrival of most spring birds is varied a week or two by the winds and weather, as a few warm days and south wind always bring them in large flocks, when the contrary conditions either delay them all, or make them arrive in scattered order. The prevalence of fogs for 20 miles inland during many nights of spring also changes the route of some or all the migrants.

AGELÆUS TRICOLOR—Red and White-shouldered Blackbird—p. 265. The eggs of this bird, instead of being like those of Brewer's Blackbird, as I quoted from Dr. Heermann, are almost undistinguishable from those of the other Redwings. Dr. Brewer calls them deeper blue; but many found by me at Saticoy, Ventura Co., are rather pale green, with few dark brown blotches and lines near the large end. The nest differs more, being of straws, stems, and leaves, twisted around several upright stems of nettles, about four feet from the ground, and in the forks of the plants. They are about 7 inches high, 5 wide, inside 3 by 3, with a fine grass lining. Hundreds built in one nettle thicket, around a marshy spot, but none in the cat-tails or rushes near by. The nettles were a protection from raccoons, etc.

CORVUS (AMERICANUS var.) CAURINUS—Western Crow—p. 285. Prof. Baird still insists on the specific distinctness of this form, as found from the Columbia River to Sitka, returning all Californian specimens to *C. Americanus*. The differences now first given by him are, "tarsus shorter than the bill, 1st quill longer than 10th, gloss deeper," besides the smaller size. But the plates in his former work, and the tables given with them, do not show such a constant difference in bill and tarsus as "culmen, 1.95; tarsus, 1.70," nor do they show any marked disproportion in the wings or tarsi of the two "species." The var. *Floridanus* is quite as peculiar in having larger bill and tarsus, but many intermediate specimens, some of which I myself collected at Ft. Dallas, Fla., connect it with *Americanus*.

In the same way the California birds connect the var. *caurinus* with *Americanus*. In his former work, Prof. Baird himself mentions the less graduated tail of Californian skins, and includes in *caurinus* several northern specimens of intermediate sizes.

Finally, the eggs show a regular gradation between the smallest northwestern and largest Floridan. The most peculiar habit of northwestern birds is that mentioned by J. K. Lord, in the close resemblance of their nests to those of the magpie. But as they do not build such nests near the mouth of the Columbia where no magpies are found, I have no doubt that those he saw thus used had been stolen from the magpies by the stronger crows.

PICA? (PICA var.) NUTTALLI—Yellow-billed Magpie—p. 295. This variety or race of the circumboreal *Coracias Pica* Linn. 1735, is not common near Monterey, as was stated on authority of Dr. Canfield, as I saw only two or three pairs within six miles. and a native of the place told me he had not seen so many before in thirty years. They are, however, great wanderers, like the other races, and may reside a few years at a place which they afterwards desert for a longer or shorter period. I have been told that they were formerly numerous in places where none are now found, and in 1855 I found them common twenty miles nearer San Francisco, to the south, than they were in 1873, when I saw none nearer that city than sixty miles in any direction.

One reason may be the reckless scattering of poisoned grain by the farmers to destroy squirrels, which has also destroyed the quails and numerous small birds, besides driving off or killing the crows and jays. But, on the other hand, in 1860 I found the var. *hudsonica* numerous at Ft. Vancouver, Columbia River, where I saw none in 1853–4, but where Townsend and Nuttall saw a few also in 1834. The high cold winds are sufficient cause for their permanent absence from near S. F. Bay, where several other birds are equally absent for the same reason, especially those of non-migratory habits.

CYANURA STELLERI—Steller's Jay—p. 298—(var. *frontalis* Ridgw. 1874). I found a few of these birds breeding in the dense pine woods at Monterey in 1874, and shot a young bird of the year in July, 1875, about 25 miles east of San Francisco, which had probably been raised in the redwoods at least 12 miles distant.

CONTOPUS BOREALIS—Olive-sided Flycatcher—p. 323. The statement by myself that this bird is "resident" north of Monterey is not confirmed by late observations, though I have never seen any migrating through the southern part of California, which ought to be as well suited for them in winter as Texas. If they fly from one pine-clad range to another when migrating, without stopping on the way, their journeys must be long and far to the eastward.

CONTOPUS RICHARDSONII—Short-legged Flycatcher—p. 325. Although most late authors rank this as a western race of *C. virens*, they do not mention intermediate specimens, and the differences, from their own accounts, appear quite marked. This has the wings longer and more pointed, feet larger and stouter, darker back, no light space on breast, more forked tail, and different notes and habits. Both breed in Texas and both winter in Central America, apparently without mixing. The two species are as different as *C. borealis* and *C. pertinax*. The western bird, though ranging to Wisconsin, can scarcely be supposed to reach Labrador habitually, and it now appears that Audubon's description of the nest and eggs found there was entirely incorrect, answering better to that of some warbler.

EMPIDONAX (PUSILLUS var.) TRAILLII—Traill's Flycatcher—p. 327. I have no doubt that the Colorado valley specimens mentioned were of this race, though the differences between it and var. *pusillus* are now narrowed down by intermediate specimens to a more brownish-olive color, and darker wing-bands, shorter tail and tarsus. I have since found other specimens connecting them not uncommon in Ventura Co., where I saw none until May 22d, when their peculiar notes became noticeable. These differ from any I have ever heard uttered by the true *pusillus*, which is an abundant species in the north, and was only by accident omitted in my published report on Cal. Ornithology. The whole description of its nest, eggs and habits was by a blunder inserted under *E. Hammondii* on p. 331, from line 9 to 28, which species was reported by Baird, from Monterey.

E. (FLAVIVENTRIS var.?) DIFFICILIS.—Yellow-bellied Flycatcher—p. 328. The western race of this species proves to be really more different from the eastern than that of the preceding, and especially in laying spotted eggs, which, indeed, scarcely differ from those of *E. pusillus*. If the allied *Sayornis* (and some other birds) did not show a similar, though less marked, variation in its eggs, independent of regional variations in plumage, we might decide from this the question of identity, but there seem in this case, also to be intermediate birds. At Haywood, Alameda Co., I found about twelve nests and captured enough birds on them for certainty. All were built in the hollows outside or inside of stumps and trees from two to ten feet above ground, or against the walls of little caves in rocky banks, and two on timbers under sheds. Mud is used for the shell, covered outside with much green moss and lined with fine grass, fibres, etc., thus being quite different from that of the eastern bird as described.

The eggs varied a good deal in size and form, usually being larger than those of *pusillus* from Santa Cruz, length 0.73 to 0.62 by 0.58 to 0.52. Even when under sheds the green moss was liberally used, making the nests even more conspicuous than without it. This was the only species I found breeding near Haywood, and it arrived there March 31st, though I found them near Santa Barbara by the 21st, in 1873, three weeks earlier than noticed at San Diego. The differences in the two races seem to be wholly in shades of color and size, not in proportions, as formerly supposed, when young autumn specimens of var. *difficilis* were the types described.

CHÆTURA VAUXI—Oregon Swift—p. 357. Arrived or passed through Ventura County, northward, on April 22d, 1873, and through San Diego on April 26th, 1872. As this is now considered the western race of *C. pelagica*, and winters on the west slope of Central America, the undecided question as to where the eastern birds winter, suggests that they may either be the "var. *poliura*," of South America, or the species mentioned by Nuttall, as follows: "The wonderful account of the swallow-roosts in Honduras given by Capt. Henderson, appears to be entirely applicable to this species." (Man. I, 738.) The *C. zonaris* or some other species may, however, be referred to. I cannot consider this bird a western race only of *C. pelagica*, as intermediate forms are still unknown.

Calypte anna—Anna Hummer—p. 358. This species though mentioned by Gould as Mexican, had not been detected in the intermediate territory of Arizona until 1874, when Mr. Henshaw obtained them there. Very few of the California birds, however, leave the State in winter, if any.

I have found eggs vary from 0.60 to 0.52 long, by 0.40 to 0.35, and the nests vary half an inch in depth, according to the degree of exposure to the wind of their locations. The amount of moss put on the outside also varies, from almost none to a complete covering, as no doubt is the case with those of other species. They lay eggs as early as Feb. 1st, in lat. 38°!

Stellula calliope—Calliope Hummer—p. 363. A male of this species was shot at Haywood, Alameda Co., April 17, 1875, the first yet found west of the Sierra Nevada, and no doubt a straggler.

Geococcyx Californianus—Road-Runner—p. 368. At Saticoy, Ventura Co., I found a nest of this species built in a small Chilian pepper-tree (*Schinus molle*), growing in a hedge, containing two eggs, apparently deserted, on April 12th, 1873. It was only four feet above ground, and not much hidden, built of coarse sticks, with lining of straw and dry horse-dung. From seeing only Barn Owls about there, I supposed it to belong to that bird, the eggs agreeing more nearly with theirs in form than with the one I described, which was laid in a cage. From Dr. Brewer's account of the usual size and form of their eggs, I am, however, now satisfied that they belonged to this bird. The largest measured 1.55 by 1.20 inch. In the appendix to Dr. Brewer's work this nest is mentioned as a Barn Owl's.

Picus (pubescens var.) Gairdneri—Gairdner's Woodpecker—p. 377. This race of *P. pubescens* was in 1870 supposed to be absent from Southern California; but in 1872–3 I found it a common species in Ventura Co., lat. 35°, in the cool groves near the mouth of Santa Clara River, where it took the place of *S. Nuttalli*, a species more common in the warmer valleys farther inland. The specimens obtained are much nearer like the eastern race than those from the north.

I must here remark that, from the too liberal use of the names of favorite saints by the Spaniards, it is necessary to explain that the river above mentioned is over 150 miles south of the "Santa Clara Valley" near San Francisco Bay, mentioned as the southern limit of this species (and elsewhere in Orn. of Cal., Vol. I), which is more often called San José Valley.

Colaptes auratus—Golden-winged Flicker—pp. 410, 412. It is very remarkable that specimens differing from the eastern bird only in the black cheek-patches being tipped with red (which is reported also of Florida and New Jersey specimens), should occur close to the Pacific coast, where we would expect the characters of *Mexicanus* to predominate even in hybrids. On Nov. 21st, 1872, I shot a splendid male specimen near San Buenaventura, which can scarcely be supposed to have straggled from Alaska so far south, and, like those found near S. F. Bay, indicates some yet unexplained law of distribution. It was considerably smaller than those of *Mexicanus* shot in the same region, and probably not migratory.

The following shows the comparative sizes of these and of *C. chrysoides*, from Ft. Mojave, in same latitude:

C. AURATUS ♂; length 13 inches, extent 20.20, wing 6.35.

C. MEXICANUS ♂; length 13.75 inches, extent 21.40, wing 6.75.

C. CHRYSOIDES, ♂; length 11.75 inches, extent 19.25, wing 6.25.

The colors of iris, bill, and feet were alike, except in the last, which had the iris blood-red. It becomes again a question which of the yellow-winged species was Dr. Heermann's "*C. Ayresii*," from Cosumnes River, Cal.

In January, 1873, I shot a specimen of *C. Mexicanus* at the same locality, which attracted my attention by its pale orange-color under the wings. I found it not a hybrid, nor in any way intermediate, but a faded variety, such as is noticed in specimens of other woodpeckers from the hot, arid regions east of the Sierra Nevada. Though its plumage was fresh and not worn, its back was nearly white, with dusky bars, quills gray near ends, and other upper parts pale brown, marked as usual. It was evidently a migrant from the border of the deserts eastward, and showed that climate can have little to do with the characters of the two leading forms, or the intermediate race; which is further proved by the occurrence of two species in the Colorado valley, where no hybrids have so far been found.

The occurrence of *C. auratus* in Greenland and England makes its occasional straggling to California less remarkable; but is it not capable of naturalization here?

STRIX (FLAMMEA var.?) PRATINCOLA—Barn Owl—p. 415. Audubon's account of the nesting of this bird in the grass, though almost incredible, is not much less so than its building *underground*, as it occasionally does in California, selecting a cavity in a steep bank of earth along some stream, where the winter rains leave many such holes, perfectly dry for six or eight months of summer. I obtained five eggs from such a cavity, Apr. 10th, 1875, at Haywood, Alameda Co., where I also knew of nests in hollow trees, among branches, and in a wind-mill, whose owner wisely protected them. Bonaparte's specific name, implying a general residence in fields, was therefore badly chosen for this variety, for which the name *Americana* Aud., 1834, is also prior, and not mistakable for Gmelin's uncertain species. As this owl scarcely goes north beyond lat. 42°, and stragglers are not reported from the interval of over 3,000 miles between its range and that of *S. flammea*, an intermingling of the races must have occurred at a very remote period, if ever. In California it is resident in the northern half of the State all the year, and in winter its numbers are increased by migrants from the north, probably from as far as Oregon, where it was found by Townsend and Peale.

It would not be strange if this owl was found to enlarge its underground domicile when too small by a little burrowing, like the similar-footed but weaker Ground Owl, or as reported of the short-footed *Brachyotus* by Dall.

BUTEO SWAINSONII—White-throated Buzzard (of Nuttall)—p. 476. I shot the first specimen of the typical race recorded from California, on Oct. 2d, 1872, at Saticoy, Ventura Co. Nearly, if not quite all, breeding west of the

Sierra Nevada, are of the var. *insignatus*, while the pale race seems chiefly to prevail in the open and arid regions eastward. I found the dark race breeding down to San Diego, and they seem more common on this slope than the *B. borealis*, even to Alaska. They migrate in flocks, of which one was mentioned in the Orn. of Cal., going north in San Diego Co., April 18th, 1862, and on Apr. 16th, 1873, I saw a similar flock, entirely of *insignatus*, going north over Ventura Co. With the first were some of *Archibuteo* and other species. They returned south about Oct. 1, in Ventura Co., more or less in flocks, while no southward movement of *B. borealis* occurred until a month later. My statement that the average size of this species is equal to that of *borealis* was founded on a comparison of females of this with males of the latter. The wings are longer in proportion, which in dried skins is liable to mislead. The difference between wing and total length I found in six specimens to average only 3.72 inches, while in seven of var. *calurus* it averaged six inches. Although Dr. Brewer thinks that the nest and eggs described by Heermann as of *Archibuteo* belonged to this bird, the description of both seems to me more suited to the latter, which certainly breeds here.

Buteo (lineatus var.) elegans—Elegant Buzzard—p. 477. The description of the young which I copied from Cassin's, is wrong in giving 12 instead of 6 bars on the tail, no doubt inadvertently, as he figures it correctly in Birds of N. A. (P. R. R. Rep. X, pl. II and III). I saw a dead bird of this species in Marin Co., north of S. F. Bay in 1873, and it is doubtless the "*F. hyemalis*" of Townsend's Oregon list, as the eastern race goes north to Nova Scotia. In 1872–3, I found them constant residents of Ventura Co., and not more common in winter.

Buteo oxypterus—Sharp-winged Buzzard—p. 480. A specimen in Woodward's Museum, shot at San Diego in 1871, agrees perfectly with Cassin's plate, and I do not agree with Ridgway in considering it merely a variety of *B. Swainsoni*. Besides its smaller size, it appears to have more transverse scales on tarsus, and its wing is different, both in proportions of quills and length. The dark var. *fuliginosus* is also said to differ from *insignatus* in sooty tint, no white on forehead, under-wing coverts banded white, tail cinereous umber, with seven (not ten) bars. Other differences are noted in the Central and South American specimens, described by Ridgway. Of its relation to *B. Pennsylvanicus*, suggested by J. A. Allen, I cannot decide.

Elanus leucurus—Black-shouldered Hawk—p. 488. Mr. Ridgway's belief that the Australian birds are specifically identical, will make this the *E. axillaris* Latham (1801), var. *leucurus*, but any inter-migration of specimens between the two continents since the pliocene epoch, is more difficult to suppose than in the case of the stronger-winged Barn Owl. Our bird does not seem to go north of lat. 39°, and none are recorded from western Asia. I have seen but one or two in Ventura Co., and none south of lat. 35°, so that the California birds seem to be constant residents in the middle region of the State, where only their favorite marshes are extensive.

Ortyx Douglassii—Vigors, 1829. This is, apparently, merely a newly fledged young California Quail. The locality given, "Monterey, Cal.," goes to confirm this view, and I have found the first plumage agree closely.

J. P. Dameron stated that he had been experimenting on the propagation of Oysters and would shortly describe a method discovered by himself.

Mr. Scupham read a paper suggesting that steps be taken by the Academy to assist in bringing about the resumption of the Geological Survey.

On motion of Mr. Scupham, a Committee was appointed to examine into the matter and report at the next meeting. Messrs. Scupham, Blake and Ashburner, were appointed as such Committee.

Mr. Stearns made the following remarks on the death of Hon. B. P. Avery:

Mr. President and Members of the Academy:

Since our last meeting the telegraph has brought us sad news —information of the death of our fellow-member, the Hon. Benjamin Parke Avery, United States Minister to China, who died in the early part of November at the city of Peking.

The many excellences of the deceased, the co-operative spirit which he ever manifested in all matters pertaining to the welfare of his fellow-men—quietly, because he was singularly modest and undemonstrative, yet nevertheless persistently pursuing the even tenor of what he considered his duty—and that duty the advancement of civilization in a new State, the promotion of knowledge, whether in Literature, Science, or Art—and the general refinement and elevation of the commonwealth in which he had made his home; such qualities and such services make it eminently proper that we should inscribe on the permanent records of the Academy an appreciative recognition of his life and labors, as well as an appropriate expression of our esteem, and of sorrow for his loss.

With the example of his unassuming but honorable career before us—too brief but yet well filled with useful work—it would be in discord with its harmony to expand these remarks into formal eulogy.

In a letter dated July 5th of this year, the last which I received, he wrote:

"Shut within the walls of our Legation, we are as much alone as if we were in one of the old glacial wombs of the Sierra Nevada—to think of which makes me sigh with longing, for was I not born anew therefrom, a recuperated child of Nature? Your letter with bay-leaves was right welcome, and gave me a good sniff of Berkeley. It was pleasant to receive the University bay, although I am not an Alumnus, and can boast no Alma-Mater except the rough school of self-education."

The closing line above his autograph is "O, California, that's the land for me!" Enclosed with his letter were a few plants collected by him upon the broad summit of the mouldering walls which surround the ancient city where he died. Our friend has gone! He has found the tranquillity of the grave in a country remote from his native land—from the California he loved so much; far from those he loved and the many who knew and loved him, and who would have deemed it a privilege to have been near him at the final moment, and to have mingled their last farewells with his. The particulars of the closing scene have not yet been received. We may be sure, however, that he looked into the future without fear, and faded serenely, as the twilight sinks into night.

Those who knew him best, and who enjoyed the precious freedom of intimacy, will tell you that his life was conspicuous for its purity—his character for its many virtues—his intellect for its refined and delicate culture—his heart for its tender and generous sympathy. The possession of these qualities endear a man to his fellow-men; they constitute a charming whole whose priceless web is woven from the choicest graces of our poor humanity; they form an enchanted mantle whose shining folds hide the poverty of human limitations.

So lived and walked our friend among us, crowned with the affection and respect of all who knew him. I do not say that he was perfect, and yet if fault he had I know it not, nor never heard it named.

Here let us rest—grateful that so true a life has been a part of ours. We place our tribute on his grave, and say good friend —farewell!

Resolved, That the California Academy of Sciences has learned with profound regret of the death of the Honorable Benjamin Parke Avery, a fellow-member and late United States Minister at the Court of Peking; that we

hereby recognize and express our high appreciation of his many private virtues and public services.

Resolved, That these resolutions be spread on the records of the Academy and published in the proceedings.

Regular Meeting, December 20th, 1876.

Vice-President Edwards in the Chair.

Thirty-five members present.

Donations to the Museum were as follows: Thirty-three specimens of Scorpions from Arizona, from Dr. R. K. Nuttall; also from same donor, one crustacean and one sceloporus. F. Gruber presented a fine specimen of *Cervus Mexicanus*, mounted; *Rhaphidophora subterranea* from Mammoth Cave, Kentucky.

The Nominating Committee appointed by the Council and Trustees presented their report, nominating officers for 1876, as follows:

PRESIDENT.

GEORGE DAVIDSON.

FIRST VICE-PRESIDENT.
HENRY EDWARDS.

SECOND VICE-PRESIDENT.
H. W. HARKNESS.

CORRESPONDING SECRETARY.
THEO. A. BLAKE.

RECORDING SECRETARY.
CHAS. G. YALE.

TREASURER.
ED. F. HALL, Jr.

LIBRARIAN.
WM. J. FISHER.

DIRECTOR OF MUSEUM.

W. G. W. HARFORD.

TRUSTEES.

D. D. COLTON,
GEORGE DAVIDSON,
THOS. P. MADDEN,
R. E. C. STEARNS,
WM. ASHBURNER,
GEO. E. GRAY,
R. C. HARRISON.

Charles Wolcott Brooks, of the Nominating Committee, read a statement giving their reasons for having nominated certain of those upon the ticket presented.

On motion, the report of the Committee was adopted and the Committee discharged.

Mr. Scupham, of the Committee appointed on the question of the continuance of the State Geological Survey, reported a Memorial to be transmitted to the State Legislature, asking them to revive the Survey. The Memorial was as follows:

MEMORIAL.

To the Honorable, the Senate and Assembly of the State of California:

The California Academy of Sciences would respectfully represent that the Geological Survey is a work of great practical importance, as well as scientific and educational value, to the people of this State.

That by the action of the Legislature of 1873–74, the accumulated and unpublished material of several years' work was placed for safe keeping in the custody of the Regents of the University, where, for want of further provision, the greater portion still lies unimproved.

That there have been already published four volumes of the geological reports, viz.: one of geology, two of paleontology, and one of ornithology, besides smaller pamphlets, and several topographical maps, the beauty, accuracy and value of which are appreciated and acknowledged by all who have carefully examined them.

That of the unpublished matter already accumulated, there is the material for a second volume of geology, for a volume of botany, nearly ready to be issued, and the greater portion of the material for a second volume of ornithology devoted to the aquatic birds.

That the map of Central California is so nearly finished that the active field work of one more season would complete it. This map embraces nearly one-half the area of the State, and extending from Lassen's Peak on the north, to Visalia on the south; includes all the more important mining districts within the limits of California. The work so far done upon it is unexceptionable, and when completed, it will possess the highest practical value, will meet with a ready sale, and be the most important contribution to the geography of this coast that has ever been made.

That a general geological map of the whole State has been partially drawn and colored, and could be finished and published in such a way as to show the extent of the present knowledge of the geology of the State (subject, of course, to such improvements in detail as may hereafter be developed by future work) at no great expense.

That the U. S. Coast Survey map of the peninsula of San Francisco has been geologically colored in great detail, and only waits the means for its publication.

Finally, that these unpublished works are greatly needed for the benefit of our public schools, as well as for all the higher educational interests of the State, and that when completed, they would convey the most accurate information with regard to our coal fields, quicksilver mines, quartz veins and hydraulic washings, which cannot fail to exercise a most beneficial influence in aiding the further development of these important industries.

In view of the foregoing facts, the California Academy of Sciences would respectfully pray that your Honorable Bodies revive the State Geological Survey, and make a liberal appropriation for its continuance and completion.

On motion, the Memorial was approved and ordered forwarded.

Charles Wolcott Brooks presented an additional or supplementary report from the Nominating Committee, substituting as one of the Trustees, Dr. Geo. Hewston in place of George Davidson, and stating that it had been considered questionable whether the President of the Academy could also serve as a Trustee.

Considerable discussion ensued upon the subject, and finally John F. Miller was elected as a substitute for Professor Davidson.

The following were elected Judges and Inspectors of Election: C. D. Gibbes and T. J. Lowry, Judges; R. S. Floyd and Samuel Hubbard, Inspectors.

[The following paper, read at the Regular Meeting held July 19, 1875, should have been printed in the Proceedings of that Meeting.]

Pacific Coast Lepidoptera, No. 14.—Notes on the Genus Catocala, with Descriptions of new Species.

BY HENRY EDWARDS.

The beautiful moths included in the genus *Catocala* are among the more interesting of the larger *Noctuidæ*, and appear to have obtained their fullest representation on the North American continent. They are natives, for the most part of the northern temperate zone, and though some are said to exist in the Hawaiian Islands, and I am acquainted with one very large species, (a mutilated example of which was collected by the late Baron Terloo, and presented to me by Dr. H. Behr) which comes from the table land of Mexico, near Guadalajara, still the United States, Japan, N. China, Siberia and Eu-

rope must be regarded as the home of the genus, the number of species in our own country far exceeding that of the whole of the other districts put together. According to Staudinger's last catalogue, thirty-four species are found in Europe and the adjacent territories, including Siberia, four or five are known to exist in Japan, and probably the same number in northern China, while the list of North American forms, including those mentioned in the present paper, has increased to no less than eighty-three species. In the islands of the southern Pacific and Australia are several genera which recall the coloration and structure of *Catocala*, but are separated from it by well defined limits, and it is almost certain that no true example of the genus is to be found in the southern hemisphere. Our northern States species have been recently admirably figured by Mr. H. Strecker, in his Lepidopt. Rhopaloc. et Heterocera, while Mr. A. R. Grote, of Buffalo, has published, in the Trans. Am. Ent. Soc., Vol. 4, 1872, descriptions of the whole of those then known to him. In Mr. Grote's valuable paper he has tabulated the genus as follows:

Section 1. Secondaries black and unbanded above.
" 2. " black above, with white median band.
" 3. " various shades of red, with black median band.
" 4. " orange above, with black median band.
" 5. " black above, with narrow yellow median band.
" 6. " yellow above, with median black band.
" 7. " yellow above, without median band.

It is somewhat remarkable that, with one exception, the whole of the Pacific Coast species at present known belong to the third section, viz., those which have the lower wings of various shades of red, sections one, six and seven being entirely unrepresented. The late Baron Terloo is said by Dr. Behr to have observed at San Jose, in this State, a specimen near to *Catocala relicta* (section 2) of New England, and I myself, last year, observed in San Mateo County a very large species, with pale yellow median band, evidently nearly allied to *Catocala cerogama* (section 6). It was sitting on the trunk of a large tree of *Œsculus californicus*, but to my great regret, evaded my attempt to capture it. I could not, however, be mistaken in the color of the under wings. It is quite probable that among our oak groves many species unknown to science exist, and we may confidently hope that those of our coast now enumerated will be at least doubled in the course of a few years. It may be well to notice that these insects come readily to sugar, Mr. G. Mathew, of H. M. S. *Repulse*, being so fortunate as to capture no less than 27 specimens of *C. Aholibah*, Streck., in a single night, on some oak trees prepared by him at Esquimalt, Vancouver Island.

The following are the species at present known to inhabit the Pacific Coast:

Section 3.

Catocala californica. W. H. Edwards, Proc. Ent. Soc. Phil., Vol. 2, 1864.

"Expands $2\frac{3}{10}$ inches.

"Primaries, dark brown, with a gray tinge, the transverse lines rather indistinct, the elbowed line with two teeth, equally prominent, and otherwise

resembling *C. Marmorata*, Edw. Beyond this is a brown band, bordered by a faint serrated, grayish line, which is edged without by black. Reniform, black; sub-reniform, brown.

"Secondaries, rosy red, nearly the same shade as in *Marmorata*. Median band, narrow, almost straight, contracting in the middle, and terminating abruptly two lines before the margin. Border somewhat sinuous towards the anal angle. Apical spot, white, tinged with reddish. Fringe long and white. On the under side of secondaries, the red shade occupies two-thirds of the wing. From Yreka, Cal."—W. H. Edwards, loc. cit.

I have two undoubted examples of this species, both, however in bad condition, one of which was taken near Prescott, Arizona, and the other at Carson City, Nevada.

Catocala Cleopatra. Hy. Edw. n. sp.

Primaries, dark bluish gray, powdered with brown atoms, transverse lines rather indistinct, slightly olivaceous; the t. a. edged with black exteriorly, and with the indentations rather small; t. p., delicately shaded with brown and olive, with two teeth on third and fourth nervures, strongly marked with black. Reniform, indistinct, olivaceous; sub-reniform, whitish, somewhat angular, its longest angle pointing outwardly; above it, and interior to the reniform, is a dull whitish patch; and above the reniform, and touching the costa, is a strongly marked brownish shade. Submarginal line, gray, whitish and broadest towards the apex. Fringes, white, with brownish scales, except where crossed by the nervures where they are black.

Secondaries, bright rosy red, with fawn-colored hairs at the base. Median band moderate; broadest in the middle, not toothed interiorly, and terminating two-tenths of an inch from the inner margin. Marginal band, not broad, except at the anterior angle, slightly sinuous as it approaches the inner margin. Fringes, broadly white, flecked with brown scales. Those of interior margin, long, dark drab, paler towards the base.

Under side. Primaries, white, with the usual black bands, the basal one oblique, shading into the median a little below the middle. Median, moderate, narrowest towards the posterior margin. Marginal band, broad towards apex, shading into fawn color at extreme margins.

Secondaries. Two-thirds of the interior portion, rosy red, as in the upper side, shading into white towards the anterior margin. Fringes, white, a little yellowish at anterior angle. Head and thorax dark gray, mottled with brown and olive scales, whitish on the disc, where the scales form an almost triangular white mark, edged posteriorly with a black line. Abdomen smoky brown above, paler beneath, and there dotted with fine brown scales.

Expanse of wings, 2 60 inch.

Length of body, 1.00 inch.

Berkeley, Contra Costa County, Cal. (One ♂. Coll. Hy. Edw.)

This species may be easily recognized by the bluish gray tint of the primaries, dashed with olivaceous, while the almost regular median band of secondaries, recalls the European *C. Pacta*, and the Atlantic and Canadian *C. Concumbens*, Walk. Like all our Californian species, it appears at present to be exceedingly rare.

Catocala Mariana. Hy. Edw. n. sp.

Primaries, dark iron gray, with bluish tinge, especially towards the margins. T. a., only slightly dentate, shading into black on the costa, and terminating on the interior margin in a whitish patch. T. p., commencing at about one-third the length of costa, then running outwardly into two strong indentations, marked interiorly with black, and towards the interior margin, sinuate into a long and narrow tooth, terminating in white patch on the interior margin. Sub-terminal, whitish. Posterior margins, paler gray, with a row of well defined black dots in the intro-nerval spaces. Reniform, blackish and indistinct. Sub-reniform, open, resting on whitish space. Fringes, dull white, mottled with brownish.

Secondaries, rose color, with basal hairs and fringe of anal margin brownish. Median band, moderate, constricted in the middle, forming rather a sharp angle outwardly near its center, which is its widest part. It does not narrow into a point at its termination, but ends abruptly about three-sixteenths of an inch from the abdominal margin. Marginal band, with deeper sinuations, but otherwise resembling the previous species. Fringes, clear white, very slightly mottled with brownish. Head and thorax, iron gray. Abdomen, smoky brown, paler beneath.

Under side, as in *C. Cleopatra.*

Expanse of wings, 2.50 inch.

Length of body, 1.00 inch.

Vancouver Island. Hy. Edw. and G. Mathew.

Closely resembling *C. Cleopatra*, and the Atlantic *C. Briseis*, but differing from the former by the darker color of the primaries, the duller and more scarlet red of secondaries, and by the less regular median band; and from *Briseis* by the broader band of secondaries, and by its abrupt termination far from the abdominal margin.

Catocala Faustina. Strecker. Lepid. Rh. et Heter., No. 3, Page 21.

"Male. Expands $2\frac{5}{8}$ inch.

"Body above, gray; beneath, white.

"Upper surface. Primaries, bluish gray, powdered with brown atoms; marginal spots, transverse lines and bands, well defined. Reniform, distinct and surrounded by an outer circle, which is produced in two points on exterior. Sub-reniform, white; above this, and interior to the reniform, is a white space. Fringe, light gray.

"Secondaries, scarlet. Median band, moderately wide, angulated at center outwardly, and terminating somewhat abruptly about two lines from the abdominal margin. Marginal band, with a deep indentation between the first and second median nervules. Apical spot and emarginations, rosy. Fringe, on exterior margin, white; on interior margin, gray.

"Under surface. Primaries, white.

"Secondaries. Interior two-thirds rosy; towards costa, this color becomes lost in white; almost imperceptible indications of a discal lune."—STRECKER, loc. cit.

Arizona, Wheeler Expedition, 1871. Coll. H. Strecker. Dr. H. Behr, Nevada.

Catocala Perdita. Hy. Edw. n. sp.

Very closely allied to the last species, and, but for Mr. Strecker's assurance to the contrary, I should have considered it identical. The transverse lines, however, are heavier, and the reniform spot is more distinctly gray in color. The mesial band of secondaries is wider, and continued further towards the abdominal margin. The apices are pure white, without any tint of rose color, and the amount of red on the lower side is very decidedly less than is to be found in *Faustina.* In other respects I can perceive no difference.

San Mateo County, Cal. (Coll. Hy. Edw.)

Catocala Hippolyta. Hy. Edw. n. sp.

Primaries, pale silver gray, the whole of the lines brownish, distinct. T. a., shaded with dark, particularly on costa. T. p., with the teeth very regular, almost in a line with each other, and of equal length. Reniform, brownish, indistinct. Sub-reniform, whitish, not connected with the t. p. line. Subterminal line, with regular teeth, but pale and rather indistinct.

Secondaries, yellowish red, same color as in *Parta.* Marginal, broad on apex, unusually narrow towards abdominal margin, where are two deep indentations. Mesial band, exceedingly narrow, widest in the middle, terminating very abruptly about two-tenths of an inch from the margin. Apices and marginations, slightly rosy. Fringe, white. Under surface, as in *Perdita.*

Head and thorax, gray, mixed with white. Abdomen, pale grayish drab.

Expanse of wings, 2.75 inch.

San Mateo County, Cal. (Coll. Hy. Edw.)

This is a beautiful and strongly marked species, the very pale gray of the primaries, and the remarkably narrow mesial band of secondaries, serving to distinguish it from any other with which I am acquainted.

Catocala Luciana. Hy. Edw. n. sp.

Primaries, brownish, gray, with yellowish tinge; the whole of the lines and spots very heavy and strongly marked, shading into black on the margin. Reniform, large, blackish, surrounded by paler ring. Sub-reniform, distinct, open, fawn drab.

Secondaries, yellowish red, color of *Parta.* Marginal band, rather narrow and regular, with only slight indentations near abdominal margin. Mesial band, also narrow, widest in center, and terminating abruptly about two-tenths of an inch from abdominal margin. Apices, with an orange tint. Fringe, yellowish white.

Under surface, yellowish white; inner half of secondaries, red; the bands, all narrow.

Expanse of wings, 3.00 inch.

Colorado, T. L. Mead. (Coll. Hy. Edw.)

Catocala Irene. Behr. (Trans. Am. Ent. Soc., 1870.)

Primaries, yellowish brown, paler along the margins. The lines are all indistinct, and lost in the brown shading of the wings. T. a., almost obsolete.

T. p., with two deep teeth, above the middle, directed towards the apex, and surmounted by a blackish shade. Sub-terminal line grayish, with regular teeth. Reniform, small, brown. Sub-reniform, almost obsolete, connected with a paler shade, which touches the costa.

Secondaries, yellowish scarlet, color of *Unijuga*. Marginal band, moderate, rather deeply toothed towards abdominal margin. Mesial, rather narrow, slightly constricted in the middle, and terminating in a point about one-eighth of an inch from margin. The under side of secondaries has an unusually large proportion of red.

Expanse of wings, 2.60 inch.

Fort Tejon, Coll. Br. Behr. Mendocino Co., Cal., Coll. Hy. Edw.

Mr. Strecker expresses some doubts as to the identity of my specimen with Dr. Behr's species, (Lepid. Rhop. et Heter., page 100) but, upon again carefully comparing them, I am convinced that they are alike, and in this opinion I am sustained by Dr. Behr. The species resembles *Unijuga* in the color of the secondaries, but it is much smaller, and is very widely separate in the ornamentation of the superior wings, which are browner and more confused than those of its Atlantic relative.

Catocala Marmorata. W. H. Edwards. (Proc. Ent. Soc. Phil., Vol. 2, 1864.)

"Expands 4 inches.

"Head and thorax, light gray. Abdomen, wanting.

"Upper surface. Primaries, pale gray and white, more or less powdered with dark gray or blackish atoms, and bear a superficial resemblance to the European *C. Fraxini*. Transverse lines, black. Beyond the t. p. line, a brown band, succeeded outwardly by another, which is much narrower, and pure white. Reniform, dark, and shape not well defined. Sub-reniform, joined by a line to, not formed by, a sinus of the t. p. line. Fringe, white.

"Secondaries, scarlet, of a lovely shade. Mesial band, narrowed in the middle, and extends almost to the abdominal margin. Fringe, white.

"Habitation, Yreka,, Cal."—W. H. Edwards, loc. cit.

Of this grand insect, apparently the largest of all known American species, I am entirely ignorant, save through the above description and Mr. Strecker's admirable illustration.

Catocala Stretchii. Behr. (Trans. Am. Ent. Soc., 1870.)

Primaries, silver gray, very distinctly mottled with black irrorations. Lines, all faint. T. a., whitish, and with very small teeth, running its length almost straight and without deviation. T. p. also nearly straight, and with even indentations. Reniform, blackish, with a double ring. and surrounded by a dark cloud. Sub-reniform, whitish, with a fawn-colored tinge; rather small but very distinct. Sub-terminal line runs parallel to the t. p.

Secondaries, yellowish red, paler than in *Parta*. Mesial band, very narrow, scarcely constricted in the middle, and turning into a very distinct hook. about two-tenths of an inch from the abdominal margin. Marginal band nar-

row, with two small indentations near anal angle. Apices and marginations, very broadly white.

Thorax, gray. Abdomen, smoky drab.

Under side with usual bands, and half the secondaries yellowish red.

Expanse of wings, 2.85 inch.

Virginia City, Nevada, R. H. Stretch. (Coll. Dr. Behr.)

A very distinct species, of which the specimen in Dr. Behr's collection is the only one known to me. No other species has the hook of the mesial band so distinct as this, and the lines of the primaries are more regular and parallel to each other than in any other with which I am acquainted.

Catocala Aholibah. Strecker. (Lepid. Rhop. et Heteroc., Page 72.)

"Expands 3 inches.

"Head and thorax above, dark brown, with scattered white and gray scales. Abdomen, brown. Beneath, light brownish gray.

"Upper surface. Primaries, dark brown, frosted, and intermixed with white and gray; a white space adjoining the reniform, inwardly; reniform, indistinct; sub-reniform, very small, white, surrounded with black, and entirely disconnected with the transverse posterior line. Secondaries, crimson with brownish hair at the base; median band, rather narrow and regular, and continued to within a short distance of the abdominal margin, where it turns upwards, and is lost in the brownish hair that clothes that part.

"Under surface. Primaries, crossed by three black bands, none of which join or merge with each other; the spaces between the base and sub-basal band, and between the latter and the median band, are orange colored, inclining a little to crimson at the interior margin; the space between the median and marginal bands is white; fringe, white, with black at the termination of the veins. Secondaries, inner two-thirds, crimson, a little paler than on upper side; rest, white; marginal band, tinged with gray at and near the costa; median band terminates about one line from the abdominal margin; slight indications of a discal crescent, connecting with the median band; fringe, white.

"Habitation, California."—H. Strecker, loc. cit.

The above description was drawn up by Mr. Strecker from a ♀ presented to him by Mr. J. Behrens. The ♂, of which two specimens are in my collection, is smaller (2.60 inch.), the mesial band is wide, and reaches fully to the abdominal margin, while at the base of secondaries is a deep black shade formed by the hairs covering that region. The brown mottled shades of primaries are also much darker and richer, and the lines and spots more distinct.

C. Aholibah appears to be the most common of the Pacific Coast species, and is found from San Francisco to Vancouver Island, in which latter locality it is, as I have previously stated, quite abundant. It is by no means confined to the "higher mountains of California," as Mr. Behrens formerly imagined, that gentleman having recently taken a fine specimen at Saucelito, on the shores of our bay. I have received examples from Oregon and Washington Territory.

For the purpose of comparison, I am induced to add a description of the Mexican species spoken of at the commencement of this paper:

Catocala Cassandra. Hy. Edw. n. sp.

Primaries, dull gray, clouded with black. Lines, all distinct and regular. T. a., nearly straight, and with the indentations small. T. p., slightly bent on costa, with small and regular teeth, running obliquely from its center to interior margin, wanting the usual elbowed line, and reaching the margin behind its center. Sub-terminal line, almost obsolete. Reniform, black, surrounded by a black cloud, which reaches from costa to interior margin. Subreniform, whitish, indistinct.

Secondaries, pale red. Mesial band, narrow; of equal width for more than half its length, then abruptly narrowed, and bending almost at a right angle to abdominal margin. Marginal band, broad at the apex, with the indentations near anal angle moderate. Apices white, tinged with orange red. Fringe, white.

Under side. Usual bands, the mesial of secondaries terminating abruptly about two-tenths of an inch before reaching abdominal margin, and not continued to the margin as in the upper side. Inner half of secondaries, pale red.

Expanse of wings, 3.60 inch.

Guadalajara, Mexico, Baron Terloo. (Coll. Hy. Edw.)

Its large size, primaries clouded with black, and the peculiar form of the mesial band of secondaries, will serve to distinguish this from any other known species.

Section 4.

Secondaries, orange above, with black median band.

Catocala Zoe. Behr. (Proc. Ent. Soc. Phil., 1870.)

Primaries, rich brownish gray, mottled with white, the basal portion darkest. Across the center of the wing reaching from the base to the t. a. line, is a black dash, surmounted by some clear white scales. The t. a. is richly clouded with black, and only slightly dentate, chiefly towards the interior margin. T. p., black, with two large central teeth, and four smaller ones, of equal size, running towards the interior margin. The sub-terminal line is clear white, with the indentations small and regular. Reniform, large, whitish, surrounded by a double ring. Sub-reniform, very small in the ♂, large in ♀, open, and in the latter sex joining the t. p. line. Fringes, gray, mottled with brown.

Secondaries, bright orange, clouded at the base by brownish hairs. Mesial band, narrow, broadest in center, much constricted near abdominal margin, and there turned upwards, reaching the margin about its middle. Marginal band, moderate, very deeply bi-dentate near the anal angle. Apices and marginations, deep buff. Fringe, dirty white, alternated with brownish black.

Head and thorax, gray, mottled with white. Abdomen, smoky fawn color.

Under side. Usual bands, the lighter ones of primaries being largely suffused with orange, and the same color occupies nearly two-thirds of the secondaries.

Expanse of wings, 2.50 inch. ♂, 3.05 inch. ♀.

Napa and Marin Counties, Cal. Vancouver Island. (Coll. Dr. Behr. H. Strecker. Hy. Edw.)

This species very closely resembles both *C. Ilia* and *C. innubens* of the Atlantic States, but differs very materially from both in the pale color of the secondaries and by the more deeply toothed marginal band. The shading of the primaries very nearly approaches that of *Ilia*, but the lines are clearer, and more decidedly mottled with white.

It will thus be seen how very small is our present list of *Catocalæ*, compared with those of the Atlantic States, and yet, as the plants on which the caterpillars feed, viz., oaks, willows and poplars, are common throughout the State, we might reasonably look for an abundant harvest of species. Perhaps more collectors in the field, and a determined and energetic search for them in their haunts, will yield us a larger number of these beautiful moths, which at present, not alone in species, but also in individuals, may be ranked among the greatest of our entomological rarities. The following are noticed in this paper, the names of those which I have described as new having been derived from the heroines of Shakespeare's plays:

Catocala Californica.............W. H. Edw.
" *Cleopatra*.............Hy. Edw. n. sp.
" *Mariana*.............Hy. Edw. n. sp.
" *Faustina*.............Strecker.
" *Perdita*.............Hy. Edw. n. sp.
" *Hippolyta*.............Hy. Edw. n. sp.
" *Luciana*.............Hy. Edw. n. sp.
" *Irene*.............Behr.
" *Marmorata*.............W. H. Edwards.
" *Stretchii*.............Behr.
" *Aholibah*.............Strecker.
" *Cassandra*.............Hy. Edw. n. sp.
" *Zoe*.............Behr.

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